This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

WIDENER LIBRARY
HX GNT8 /

Digitized by Google

Sci 772.5 (1881-99)

HARVARD COLLEGE

SCIENCE CENTER
LIBRARY

Digitized by Google

Digitized by Google

Digitized by Google

~~Educ R 702.2.5~~ 30
Yale College — Winchester Observatory.
Sci 772.5
4x

Your attention is respectfully invited to the report, on page 17, concerning the verification of Clinical Thermometers.

REPORT FOR THE YEAR 1882–1883 OF H. A. NEWTON, DIRECTOR, TO THE BOARD OF MANAGERS OF THE OBSERVATORY IN YALE COLLEGE, PRESENTED BY THEM TO THE PRESIDENT AND FELLOWS; TO WHICH IS APPENDED THE REPORT OF THE ASTRONOMER IN CHARGE OF THE HOROLOGICAL AND THERMOMETRIC BUREAUS.

Digitized by Google

We herewith transmit to the President and Fellows of Yale College, the report of the Director of the Observatory.

Respectfully,

C. S. LYMAN, *Pres.*
E. LOOMIS,
J. CAMPBELL,
T. G. BENNETT,
H. A. NEWTON.

YALE COLLEGE, June 18, 1883.

Digitized by Google

REPORT.

GENTLEMEN—During the past year the work in the Horological and Thermometric Bureaus has been carried on by Mr. Willson and Mr. Sherman under the charge of Dr. Waldo. His report is herewith submitted. The service which the Bureaus are doing for the community is of the highest value, and I believe will be more and more appreciated as it becomes better known.

So much of the main building of the Observatory as was contracted for at the date of last year's report has been finished. The mounting of the two domes has been done by Mr. Willson.

The Heliometer has been mounted and brought into position by Dr. Waldo. The driving clock by reason of its attachment to the heliometer-stand gave a slight tremor to the instrument. It was therefore removed to a window in the outside wall of the tower and connected with the instrument by a rod under the floor of the observing room.

Besides the observations during the Transit of Venus, Dr. Waldo has measured by various methods the constants of the instruments, and has made observations of the diameters of the Sun, Moon, Venus, Jupiter, Saturn, and Uranus.

The telescope in the east tower was generously given to the Observatory by E. M. Reed, Esq., of New Haven. It has been mounted by Mr. Willson, and was specially arranged by him for use in taking photographs of the Sun during the transit of Venus.

Besides his work in the Thermometric Bureau, Mr. Sherman has been engaged upon pendulum experiments. To carry forward these investigations, he has procured at his own expense two pendulums, which he will mount at an early day.

Digitized by Google

At the Transit of Venus observations of contacts were made by so many observers as we could procure suitable telescopes for. Professors Lyman, Brewer, Wright and Beebe, Mr. Whitmore and others joined in this work.

Dr. Waldo and Professor Kershner used the Heliometer uninterruptedly during the whole time of the transit. Their observations were recorded by Prof. Phillips and Mr. Brown. These measurements, as well as others for the instrumental constants, have been placed in Prof. Kershner's hands for reduction. In this he has already made very considerable progress.

Mr. Willson arranged the mounting of the Reed telescope by removing the object glass and inserting a small uncorrected lens, for photographing the Sun during the transit. The most important novelty was the obtaining a line of reference on the photograph by the use of a mercury cistern just in front of the photographic plate, the upper free surface of the mercury being photographed at the same time with the sun. About 80 measurable plates were obtained. None of them have as yet been measured. The principal expense incurred was borne by Mr. Willson himself.

Mr. Sherman, assisted by Prof. Beebe, made use of the telescope of the Sheffield Scientific School. A set of inclined lines was inserted in the focus of the instrument and used somewhat after the manner of a ring micrometer. About 80 transits of the Sun and Venus were observed. The reduction of these observations has been essentially completed by Mr. Sherman himself, or at his own expense.

Progress has been made in computing refraction and other tables adapted to the latitude of the Observatory.

By the courtesy of Prof. Hilgard, Superintendent of the U. S. Coast and Geodetic Survey, a station of the Survey was set near the Observatory building and connected with the well-determined stations on East and West Rocks. The geodetic latitude and longitude of the middle point between the two towers are found to be, N. lat. 41° 19′ 28.48″, W. long. 72° 55′ 19.15″. The astro-

Digitized by Google

nomical latitude is probably four or five seconds less. The difference should be exactly determined during the coming year.

The house on Caner street has been nearly, and the two on Prospect street, entirely finished. The grounds around the Observatory have been plowed, harrowed, rolled and seeded. Walks and drives have been laid out under Mr. Brown's direction, and many shrubs and trees planted. The principal part of the grading of Caner street has been accomplished. The buildings and the other improvements of the Observatory property have involved heavy expense, but it is hoped that the early sale of building lots will reduce the encroachment upon the munificent endowment of Mr. Winchester to a minimum.

Mr. W. D. Ely, of the class of 1836, has given us $400 for the purchase of instruments for observing terrestrial magnetism. The instruments have not yet been received.

We owe thanks to Mr. R. M. Everit for shrubs and plants for the Observatory grounds.

Donations to the library of the Observatory have been received from the following persons:

The Director of the Observatory at Adelaide,
" " Armagh,
" " Cambridge, Mass.
" " Chapultepec,
" " Dun Echt,
" " Liepzig,
" " Palermo,
" " Pulcowa,
" " Rio de Janeiro,
" " Washington.
The Chief of Engineers, U. S. Army,
The Smithsonian Institution,
The Chief Signal Officer, U. S. Army,
Lieut. Col. Comstock, in charge of the Lake Survey,
The Superintendent of the American Ephemeris,
The Canadian Institute,
The Superintendent of the Meteorological Service, Canada,
The Lords Commissioners of the Admiralty,
The University of Tokio,
The Science Observer,

Digitized by Google

Mr. R. Brown,
" G. J. Brush,
" S. W. Burnham,
" J. Campbell,
Messrs. J. D. and E. S. Dana
Mr. J. W. Gibbs,
" A. Hall,
" J. Janssen,
" C. S. Lyman,
" C. H. F. Peters,
" E. C. Pickering,
" T. Schwedoff,
" J. Sharpless,
" O. T. Sherman,
" A. Tischner,
" L. Waldo,
" B. Weinstein.

Respectfully,

H. A. NEWTON.

YALE COLLEGE, June 18th, 1883.

Digitized by Google

THIRD

ANNUAL REPORT

OF THE

ASTRONOMER

IN CHARGE OF THE HOROLOGICAL AND THERMOMETRIC BUREAUS

IN

THE OBSERVATORY

OF

YALE COLLEGE.

1882–1883.

PRESENTED TO THE DIRECTOR OF THE OBSERVATORY,
JUNE 18, 1883.

BY

LEONARD WALDO.

NEW HAVEN:
TUTTLE, MOREHOUSE & TAYLOR, PRINTERS.
1883.

Digitized by Google

Digitized by Google

THIRD

ANNUAL REPORT.

1882–83.

TO THE DIRECTOR OF THE OBSERVATORY:

SIR—The present report refers to the work in the Horological and Thermometric Bureaus during the year ending May 31, 1883.

THE HOROLOGICAL BUREAU.

The methods of comparing time pieces, of determining the errors of the standard clocks employed, and of making the records of the bureau, continue the same as in the last report. As anticipated the number of watches entered this year is not greater than last year, but they continue to be received from a variety of makers and show a decided improvement in quality of performance.

Owing to the interruptions incident to our building and moving into the new observatory on Prospect street, it was found inexpedient to alter the conditions of our watch trials. They remain therefore as they were.

The duration of the trials and the position of the time-pieces submitted during the past year are shown in the following table:—

Digitized by Google

Test No.	Position and Temperature.	Class of Certificate. I.	II.	III.	IV.
1	Dial up, Ordinary,	12			
2	" Refrigerator,	1	1	1	
3	" Oven,	1	1	1	
4	" Ordinary,		8	8	12 or
5	Dial vertical, Pendant up,	14	8	8	12
6	" " right,	2	2		
7	" " left,	2	2		
8	Dial down,	2			
9	" up,	8			
	Total No. days,	42	22	18	12

Table showing the number of watches received, and certificates issued, during the year ending May 31, 1883.

Entered for		Of which	
Class I. Certificates	37	8 received certificates Class	I.
" II. "	5	1 " " "	II.
" III. "	3	1 " " "	III.
" IV. "	5	4 " " "	IV.
Total number received	50		

9 remain on hand and 27 were returned to their senders as not fulfilling the necessary conditions* for obtaining any certificate.

* *Conditions of Issuing Certificates.*—No certificate of the classes I., II., III., IV., A, will be issued in the following cases:

1. When the variation of rate with the dial vertical and pendant up in classes I., II., III., and in the positions indicated in classes A and IV., exceeds 2ˢ.0 from one day to the following day.
2. When the variation of rate between the positions of "Dial up" and "Dial vertical" exceeds 10ˢ.0.
3. When the variation for 1° F. exceeds 0ˢ.3 between the ordinary temperature and the oven.
4. When the rate is greater than 10ˢ.0 per day in any position.

No certificate in the classes B or C will be issued in the following cases:

5. When the variation of rate from one day to the following day exceeds 1ˢ.0, except there be a barometric variation as great as 0.7 inches.
6. When the variation for 2° F. exceeds 0ˢ.3.

In the cases where no certificate is issued the movement will be returned to the maker with a statement of its performance.

The following tables give the individual timepieces receiving certificates during the year.

Digitized by Google

TABLE NO. I.—WATCH MOVEMENTS OBSERVED FOR 42 DAYS, IN FIVE POSITIONS, AND IN THE OVEN AND REFRIGERATOR, AND WHICH RECEIVED CLASS I. CERTIFICATES.

Rank.	Maker's Number.	Name engraved on the face of the Watch.	Escapement.	Spring.	Mean daily rate.	Mean daily variation.	Variation for 1° Fahr.	Diff. bet. Pendant up and Dial up.	Diff. Pend't up and Pend't right.	Diff. Pend't up and Pend't left.	Diff. Dial up and Dial down.	Diff. bet. extremes of rate.	Mark computed for			Total.
													Daily Variation.	Position.	Temperature.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	263137	Vacheron & Constantin.	Anchor.	Breguet.	−0.38	0.40	+0.06	−1.94	−0.49	+1.36	+1.40	4.5	32	37	16	85
2	999995	American Watch Co.	Anchor.	Breguet.	−0.87	0.44	+0.01	+1.96	−0.27	+4.63	+2.32	5.7	31	33	19	83
3	1436	Johnson.	Chronometer.	Cylindrical.	+0.74	0.36	+0.07	+5.56	+1.52	+4.01	−1.44	8.9	33	33	15	81
4	263136	Vacheron & Constantin.	Anchor.	Breguet.	+4.36	0.65	−0.05	−0.04	+2.53	+4.33	+0.02	7.0	27	33	17	77
5	1583692	American Watch Co.	Anchor.	Flat.	−2.19	0.40	−0.05	+5.76	−2.22	−0.25	−13.55	14.7	32	27	17	76
6	871104	American Watch Co.	Anchor.	Breguet.	−4.35	0.62	+0.13	−2.48	+2.16	−0.06	+3.47	7.3	28	35	11	74
7	13533	J. Jürgensen.	Anchor.	Breguet.	+2.18	0.81	+0.08	+0.70	−4.20	+2.40	+0.80	8.1	24	33	15	72
8	6049	Schoof.	Lever.*	Breguet.	−0.06	0.63	−0.19	+0.95	+3.96	−4.71	−3.34	11.0	27	29	7	63

* Resilient attachment.

Digitized by Google

TABLE NO. II.—WATCH MOVEMENTS OBSERVED FOR THREE WEEKS, IN FOUR POSITIONS, AND IN OVEN AND REFRIGERATOR, AND WHICH RECEIVED CLASS II. CERTIFICATES.

Rank.	Maker's Numbers.	Name engraved on the face of the Watch.	Escapement.	Spring.	Mean daily rate.	Mean daily variation.	Variation for 1° Fahr.	Difference between Pendant up and Dial up.	Difference between Pendant up and Pendant right.	Difference between Pendant up and Pendant left.	Difference between extremes of rate.	Mark computed for			Total.*
												Daily variation.	Position.	Temperature.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	6331	Mermod, Jaccard & Co.	Anchor.	Breguet.	s. +3.25	s. 1.09	s. 0.05	s. −6.61	s. −6.67	s. −6.92	s. 13.4	18	30	17	65

TABLE NO. III.—WATCH MOVEMENTS OBSERVED FOR NINETEEN DAYS, IN TWO POSITIONS, AND IN THE OVEN AND REFRIGERATOR, AND WHICH RECEIVED CLASS III. CERTIFICATES.

Rank.	Maker's Number.	Maker's Name.	Escapement.	Spring.	Mean daily rate.	Mean variation.	Variation for 1° Fahr.	Diff. bet. Pendant up and Dial up.	Diff. bet. extremes of rate.	Mark computed for			Total.*
										Daily variation.	Position.	Temperature.	
	47141 N	E. Howard & Co.	Anchor.	Flat.	s. −0.74	s. −0.52	s. −0.10	s. +2.35	s. 5.8	30	35	13	78

Digitized by Google

* In order to assign to the watches sent to us for certification a certain order of merit in this report, they have been marked upon three qualities, and that watch receiving the highest sum of marks in its class has been placed first in the accompanying tables. The three qualities and the method of computing the marks assigned were:—

1°. The general performance as shown by the mean daily variation of rate, computed by subtracting such day's rate from the rate on the day following, and dividing the numerical sum of these daily variations by the number of days, but omitting the daily variations when a change of position occurred. The mark for a mean daily variation exceeding $2^s.0$ is taken as 0, and the mark for a watch having no variation would be the greatest possible. We have assumed the general performance to be equal in value to the adjustment for position, and we assume the maximum mark to be 40.

The mark for any particular watch may be computed by the formula

$$\frac{2^s.00 \text{ the mean daily variation}}{0.05} = \text{the mark for daily variation.}$$

2°. The adjustment for position, as shown by the mean of the deviations of the rates in different positions from the mean rate during the whole trial. With the assumption that this is of equal importance to (1) we have assumed the maximum mark to be 40.

The mark to be assigned to any watch has been computed from the formula

$$\frac{10^s - \text{mean position variation}}{0^s.25} = \text{the mark for position variation.}$$

This is based upon the consideration that the greatest rate in any position cannot exceed 10 seconds.

3°. The adjustment for compensation in temperature has been assumed to be of half the value of the adjustments necessary for a maximum mark in 1° and 2°, and therefore receives the maximum of 20. The mark to be assigned to any watch for this adjustment has been computed from the formula

$$\frac{0^s.30 - \text{variation for } 1° \text{ Fahr.}}{0^s.015} = \text{the mark for temperature compensation.}$$

This is based upon the consideration that the maximum limit of temperature variation is fixed at $0^s.30$ for 1° Fahr.

In the following tables, I, II, III, are given the results of the rating of watches which received certificates of the classes I., II., III., during the year. The last four columns give the numbers computed for the relative rank of the watch as compared with the others sent in to the observatory and which received certificates of the same class.

In addition to the above watch movements there was entered by H. H. Heinrichs, New York, one of his patent auxiliary compensation balance marine chronometers, for a certificate of class A. The rate of this chronometer for the last two months of its trial was as follows:—

Digitized by Google

TABLE NO. IV.—MARINE CHRONOMETER, "H. H. HEINRICHS," NO. 4," OBSERVED FOR TWO MONTHS IN ONE POSITION AND IN THE OVEN AND REFRIGERATOR, AND WHICH RECEIVED A CLASS A CERTIFICATE.

Date.	Rate.	Variation.	Temp.	Date.	Rate.	Variation.	Temp.
1883.	s.	s.	°	1883.	s.	s.	°
Feb. 23	+0.7	0.9	58	March 26	−0.2	0.2	56
24	0.0	0.7	57	27	+0.4	0.6	56
25	+0.2	0.2	56	28	+0.2	0.2	56
26	−0.4	0.6	57	29	−0.3	0.5	56
27	−0.3	0.1	60	30	−0.3	0.0	55
28	+0.5	0.8	59	31	+0.2	0.5	56
March 1	−0.1	0.6	59	April 1	+0.6	0.4	54
2	−0.1	0.0	58	2	−0.9	1.5	55
3	−0.1	0.0	57	3	−0.5	0.4	57
4	−0.1	0.0	57	4	+0.4	0.9	56
5	−0.5	0.4	56	5	−0.1	0.5	56
6	−0.1	0.4	56	6	0.0	0.1	59
7	+0.3	0.4	55	7	+0.5	0.5	60
8	−0.1	0.4	55	8	+0.3	0.2	60
9	+0.3	0.4	55	9	+0.9	0.6	59
10	+0.1	0.2	54	10	+0.4	0.5	59
11	0.0	0.1	53	11	+0.5	0.1	60
12	−0.3	0.3	53	12	+0.1	0.4	60
13	−0.2	0.1	53	13	+0.6	0.5	61
14	+0.3	0.5	55	14	+0.1	0.5	61
15	+0.2	0.1	56	15	+0.4	0.3	62
16	−0.2	0.4	57	16	+0.3	0.1	61
17	0.0	0.2	56	17	+0.7	0.4	61
18	+0.1	0.1	55	18	+0.1	0.6	62
19	+0.1	0.0	55	19	+0.2	0.1	62
20	−0.2	0.3	55	20	+0.3	0.1	63
21	−0.1	0.1	56	21	+0.1	0.2	62
22	+0.4	0.5	56	22	+0.1	0.0	62
23	+0.1	0.3	55	23	+0.2	0.1	60
24	0.0	0.1	55	24	+0.7	Oven	87
25	0.0	0.0	56	25	−0.7	Refrigerator	42

The following table gives a resumé of the watches certified during the three years of this service:—

	1880–81.	1881–82.	1882–83.
Percentage of watch movements receiving certificates of any kind,	45	38	28
Number receiving Class I Certificates,	22	12	8
Average mark of Class I Certificates,	68.8	68.6	76.4
Highest mark received during the year,	83	82	85
Maker's name,	Am. Watch Company, Waltham.	Barrand & Lunds, London.	Constantin & Vacheron, Geneva.

Digitized by Google

It will be observed that the average mark for the past year is considerably higher than for the two preceding years.

During the year the chronographs, clocks, safes and other apparatus used in this service have been transferred from the room loaned us by the Sheffield Scientific School, and the rented quarters in Orange street, to the new observatory building. The clocks are now in a specially constructed room, and the watch movements sent for trial are kept in proper fire-proof accommodations until returned. The full description of the new arrangement of clocks, safes, chronographs and electric apparatus properly belongs to the memoirs of the observatory, and will appear in that place in due season.

It has been suggested to us, from various quarters, that a school of Horology is needed in this country, similar in its scope and equipment to those abroad. It has been further urged that certain courses of the Scientific School could be utilized for the instruction of technical students in this connection, and some friends of such an enterprise are willing to furnish a part of the necessary plant. Before such an undertaking can be seriously considered by the proper authorities, it will be necessary that the endowment for at least two of the chairs of instruction should be provided for, and a sum of money for the incidental expenses of such a school be furnished by the friends of such an enterprise.

A school of this character is no doubt needed by one of our leading industries, and it will not be difficult, should the financial support be furnished, to establish a course of study and manipulation which should lead to a certificate of training and ability in this direction.

THE STATE TIME SERVICE.

The Observatory Time Signals, in accordance with the contract with the State of Connecticut referred to in my last report, have been regularly transmitted to the Railroads of the State. To encourage the public confidence in the accuracy of these telegraphic time signals, the

Digitized by Google

custom has been established of furnishing, as a news item to all the newspapers in the State, the mean monthly errors of these signals at 12 o'clock noon. The following table gives the number of days on which observations took place and the arithmetical means of the daily errors of the time signals, for the respective months:

Month.		Nights Observations.	Monthly Means of the errors of the Daily Time Signals.
1882	June,	22	$0^s.11$
	July,	24	0.15
	August,	25	0.26
	September,	14	0.48
	October,	16	0.17
	November,	22	0.20
	December,	22	0.55
1883	January,	12	0.37
	February,	13	0.71
	March,	22	1.31
	April,	19	1.68
	May,	23	0.66

The comparatively large monthly mean errors from February to May are owing to changes then made in the clocks and were in part incident to the removal of the observatory.

Three independent telegraph lines of covered wire have been built from the new observatory to the main office of the Southern New England Telephone Company, by the Standard Time Company. One of these lines is used for the distribution of the regular two second continuous time signals to the Jewellers and the Railroads, the second line is used to send an hourly current for synchronizing the clocks erected in different offices in the city by the Standard Time Company, and the third line is used for telephonic purposes.

The Hartford Time Ball continues to be dropped at noon at Hartford by our noon railroad signal, and the New York, New Haven and Hartford Railroad has a synchronized clock at Hartford, thirty-eight miles by the telegraph route from the observatory, which has been synchronized by our noon signal for several months with entire satisfaction. The whole question of railroad time

Digitized by Google

will be much simplified after the general introduction of clocks which are set at the same instant by telegraph throughout systems of railroad telegraph lines.

Through the courtesy of the Standard Time Company and the Southern New England Telephone Company, we were enabled to place ourselves in direct telegraphic and telephonic communication with the "Transit of Venus" expedition which was stationed at Hartford during October, November and December. We furnished them with our time signals twice per day during this interval, and the service we rendered them has been appropriately recognized by the "Commission für die Beobachtung des Venus-Durchgangs," through its secretary, Professor Auwers.

THE THERMOMETRIC BUREAU.

The number of thermometers received for examination continues to increase. There has been a total of 5295 certificates issued, as follows:

21 with mercurial standards up to 100° C.
31 with mercurial standards up to 275° C.
12 with Yale Observatory standard thermometers.
1 with minimum meteorological alcohol thermometer.
51 with maximum meteorological mercurial thermometers.
39 with ordinary meteorological mercurial thermometers.
5140 with physicians' clinical mercurial thermometers.

Compared with the two preceding years' work the figures are as follows:

	1880–81	1881–82	1882–83
Physicians' thermometers examined,	1667	3811	5140
Other thermometers examined,	290	741	155
Total,	1957	4552	5295

The decrease in the number of thermometers other than Physicians, is owing to the fact that the greater portion of the thermometers for the Signal Service of the Army are now compared at their Washington office, with the apparatus and standards furnished by us to them for this purpose. There have been 300 thermometers received for sealing, to be examined in one year or later.

Digitized by Google

The percentage of breakage continues about the same. During the past year 30 were broken owing to bad packing and careless handling before reaching the observatory, and 7, or about 1 in 800, were broken during examination at the observatory. On March 1st a revised scale of observatory fees* was issued with the object of encour-

***SCALE OF CHARGES FOR THERMOMETER CERTIFICATES.**
Revised March 1, 1883.

Comparison Number.	Kind of Thermometer.	At what points Certificates of Comparison are furnished in Fahrenheit or corresponding Centigrade degrees.	Limit within which the Observatory comparison is accurate.	Observatory Fee for each Thermometer compared.
1	Clinical or Physicians',	90°, 95°, 100°, 105°, 110°,	1/8° or 1/10°	$0.50
2	Ordinary Meteorological, Mercurial or Spirit,	32°, 52°, 72°, 92°,	1/10°	.50
3	The same,	2°, 32°, 52°, 72°, 92°, 112°,	1/10°	0.75
4	The same,	Every 10° from 0° to 100°,	1/10°	1.00
5	Ordinary Meteorological, Maximum or Minimum,	32°, 52°, 72°, 92°,	1/10°	.75
6	The same,	2°, 32°, 52°, 72°, 92°, 112°,	1/10°	1.00
7	The same,	Every 10° from 0° to 100°,	1/10°	1.25
	Standards,	Every 20° from 32° to 212°,	1/10°	2.00
8	The same,	Every 10° from 32° to 212°,	1/10°	3.00
9	The same,	Every 5° from 0° to 215°, and depressed freezing point	1/10°	5.00
10	Chemical,	Every 20° from 32° to 212°,	1/8°	1.25
11	The same,	Every 20° from 32° to 332°,	1/8° above 300°	3.00
12	The same,	Every 20° from 32° to 632°,	1/8° above 300°	†5.00
13	The same,	Every 20° from 32° to 212°,	1/10°	2.00
14	The same,	Every 20° from 32° to 632°,	1/2°	2.00
15		by calibration above 212°,		
16	Oil Testing Thermometers,	Every 5° from 80° to 150°,	1/8°	1.50
17	The same,	Every 5° from 80° to 150°,	1/10°	2.00
18	The same,	Every 5° from 80° to 250°,	1/10°	4.00
19	Thermometers of precision,	32° point, boiling point and depressed freezing point determination,	1/50°	2.50
20	The same,	Each additional point,	1/50°	.25
21	Boiling point standards,	Every 2° from 190° to 214°,	1/50°	2.00

† This comparison differs from 14 in determining certain points between 212° and 632° by direct comparison.

Quantity discount allowed when six or more thermometers of the same class are sent at the same time:

On ½ dozen,	20 per cent.	On 6 dozen,	40 per cent.
On 1 "	25 "	On 12 "	45 "
On 2 "	30 "	On 24 "	50 "
On 4 "	35 "		

Digitized by Google

aging the sending of thermometers in large lots. This result has been attained with the advantage of giving us more time for researches in Thermometry. Mr. Sherman has been conducting, researches in regard to the Air Thermometer, and in connection with his regular work, in regard to methods for comparing at temperatures above 100° C. This latter problem is one of peculiar importance to us, because in many of the arts there are now needed considerable numbers of thermometers fairly accurate to the boiling point of mercury.

We have added to this department, during the year, the following pieces of apparatus:

1. Boiling point Standard Thermometer "R. Fuess 32." Graduated from $-1°.50$ to $+1°.00$ and from $86°.25$ to $+100°.50$ C. $1° = 9.40^{mm}$. Smallest graduation is $0°.05$ C. and 270^{mm} extreme length. Cylindrical bulb 25×7.5^{mm} and porcelain scale.

2. Normal Thermometer "R. Fuess 133." Graduated from $-6°.9$ to $+101°.0$ C. $1° = 3.72^{mm}$. Smallest graduation is $0°.10$ C. and 563^{mm} extreme length. Cylindrical bulb 20×6^{mm} and porcelain scale. (This thermometer is to replace "Fuess 89," which was broken).

3. Water Comparator—Fuess form—for comparing short standards.

4. Linear Comparator—for calibrating thermometers and comparing measures—by Zeiss, of Jena. Fitted with two microscope stands (Zeiss 6048 and Zeiss 6023), with Zeiss objectives A, Beck objectives 4 inch, and Zeiss micrometer eye-pieces to 2.

Mr. Sherman has investigated the methods for the examination of hydrometers, at the instance of the State Board of Health of New York. Seven instruments of this kind were examined. Hereafter we can perform this service without difficulty for any such number as are likely to be sent to us.

Mr. R. W. Willson has had the care of moving the horological bureau and its work during the year, and Mr. O. T. Sherman has had a similar responsibility for the thermometric bureau. These departments have been strengthened by the appointment by the corporation of Robert Brown, Jr., to the secretary of the observatory,

Digitized by Google

in which capacity he has assumed the care of the observatory property, accounts, and the issuance of certificates of all classes.

Respectfully submitted,

LEONARD WALDO,

Astronomer in Charge of the Bureau.

To Prof. H. A. NEWTON,

Director of the Observatory in Yale College.

Digitized by Google

YALE COLLEGE OBSERVATORY

THERMOMETRIC BUREAU.

A CIRCULAR* DESCRIPTIVE OF THE CERTIFICATES PROVIDED THERMOMETERS AND THE CONDITIONS UPON WHICH THEY ARE ISSUED.

YALE COLLEGE OBSERVATORY.

BOARD OF MANAGERS.

President NOAH PORTER, D.D., LL.D.
THOMAS G. BENNETT, Ph.B.
JACOB CAMPBELL.
Professor CHESTER S. LYMAN, M.A.
Professor ELIAS LOOMIS, LL.D.
Professor HUBERT A. NEWTON, LL.D.

OFFICERS.

ROBERT BROWN, JR., M.A., Secretary.
LEONARD WALDO, S.D.
ORRAY T. SHERMAN, B.A.
WILLIAM L. ELKIN, Ph.D.

* Circulars of the Horological Bureau will be mailed upon application.

Digitized by Google

THE Observatory will compare with its standards any thermometer for which such comparison is desired. The resulting corrections refer to the date of comparison. On account of the unstable nature of glass the size of the thermometer's bulb constantly varies. The rapidity and amount of these changes depend upon the manipulation of the maker, the time elapsed since manufacture and the use to which it has been subjected. For a thermometer over a year and a half old this change is seldom more than fifteen hundredths of a degree centigrade in a year. For a thermometer over two years old seldom more than a tenth. During the first year it may amount to a degree or more. The change may take place suddenly or grow slowly. There is reason to think that by far the majority of thermometers put into the market are less than six months old when graduated. In that case, however skilled the workmanship, they require examination before use in careful research.* The various errors depending upon the glass employed render it desirable that such examination be by comparison with some adopted scientific standard.

The thermometers are compared in a vertical position with stem fully immersed in a bath whose temperature does not vary more than a few hundredths of a degree during the time required by the thermometer to take its temperature.

In reading, the reflections of the scale upon the mercury column are brought into coincidence with the divisions themselves.

Corrections are given for every five, ten, fifteen or twenty degrees as may be deemed advisable. Corrections to intermediate points are usually obtained with sufficient precision by simple interpolation.

In self-recording instruments the index may introduce errors by slipping in the tube or by moving by jerks. When faults appear during comparison corrections will be given to those points only which appear trustworthy. Where cause to suspect such errors appears, the thermometers are usually re-examined. In no case will a correction be given where the thermometer does not repeat itself to the quarter of a

* It follows that in general a re-examination of the thermometer at a later date is desirable.

Digitized by Google

degree. In clinical thermometers corrections at the nearest trustworthy point will replace those at either end of the scale when these are uncertain. The defects may sometimes be removed, but in no case will this be attempted unless in compliance with request, in which case a charge covering the necessary expense will be made. Under the same conditions the observatory will undertake to restore a lost index.

Many thermometers intended for high temperatures suffer an elevation of the zero point when heated above a point determinable only by experiment. Corrections will not be given above such a point.

Thermometers intended for accurate measurement should be stored for at least sixteen months after manufacture and before graduation. To afford the public assurance of this, the observatory will receive from the makers tubes still ungraduated, but named and numbered, and will place them under seal. The certificates issued with such thermometers will state the time elapsed between sealing and certifying. The charge for such certificates will be 10 per cent. additional, subject to the quantity discount.

For purposes of identification, each thermometer should have etched upon its stem both a name and number. When not sufficiently identified, the current observatory number will be etched upon them. Such marking will be at the rate of 50 cents per dozen.

In cases where a certificate is returned torn or defaced, or where the observatory is assured that one has been destroyed, it will issue a duplicate, so described on its face. For this a fee of 10 cents will be charged.

The observatory will refuse certificates to instruments so faulty as to be unreliable.

Clinical and ordinary meteorological thermometers will usually leave the observatory within three days after receipt. For other classes the time will be longer. In all cases two days are desired. The observatory cannot be responsible for breakages which occur, either in shipment or in manipulation. Every possible precaution will be taken, but absolute safety is still unattainable. Experience has shown that in manipulation one in a thousand and in transportation one in four hundred are broken. These latter breakages usually result from improper packing.

Digitized by Google

When trusted to express or mail carriage the box containing the thermometer should be wrapped in cotton, with paper wrapper, and this package be placed in an outside box, with excelsior packing or its equivalent. New York makers desiring to send thermometers by hand, may do so by leaving them with Lockwood's Private Express, care Oelschlaeger Bros., 162 William street.

Checks and money orders should be made payable to YALE COLLEGE OBSERVATORY.

All packages and communications should be addressed

THERMOMETRIC BUREAU,
YALE COLLEGE OBSERVATORY,
NEW HAVEN, CONN.

SCALE OF CHARGES FOR THERMOMETER CERTIFICATES.

No.	Kind of thermometer.	Points on the Fahrenheit scale at which compared.	Limit of accuracy.	Observatory Fee.
1	Clinical,	90°, 95°, 100°, 105°, 110°,	$\frac{1}{5}$ or $\frac{1}{10}$	$0.50
2	Ordinary meteorological,	32°, 52°, 72°, 92°,	$\frac{1}{5}$ or $\frac{1}{10}$	.50
3	Ordinary meteorological,	2°, 32°, 52°, 72°, 92°, 112°,	$\frac{1}{5}$ or $\frac{1}{10}$	1.00
4	Ordinary meteorological, minimum or maximum,	32°, 52°, 72°, 92°,	$\frac{1}{5}$ or $\frac{1}{10}$	.75
5	Ordinary meteorological, minimum or maximum,	2°, 32°, 52°, 72°, 92°, 112°,	$\frac{1}{5}$ or $\frac{1}{10}$	1.25
6	Physical standards,	Every 20° from 32° to 212°,	$\frac{1}{10}$	2.00
7	Physical standards,	Every 10° from 32° to 212°,	$\frac{1}{10}$	3.00
8	Physical standards,	Every 5° from 32° to 212° and depressed freezing-point,	$\frac{1}{10}$	5.00
9	Chemical,	Every 20° from 32° to 212°,	$\frac{1}{5}$	1.25
10	Chemical,	Every 20° from 32° to 300°,	$\frac{1}{5}$	2.00
11	Chemical,	350°, 400°, 450°, 500°, 550°, Per point,	$\frac{1}{5}$	.40
12	Thermometers of precision	32°, 132°, 212°, and depressed zero-point,	$\frac{1}{50}$	2.75
13	Thermometers of precision	Each additional point,		.25
14	Sealing, with certificate of age, 10 per cent additional.			
15	Duplicates of Certificates lost or destroyed,			.10

The charges on Thermometers not included herein will be given on application.

The following discounts will be allowed when six or more thermometers of the same class are sent at a time:

On ½ dozen, ... 20%
On 1 dozen, ... 25%
On 2 dozen, ... 30%
On 4 dozen, ... 35%
On 6 dozen, ... 40%
On 12 dozen, ... 45%
On 24 dozen, ... 50%

Digitized by Google

Sci 772.5

Report for the Year 1883–4, presented by the Board of Managers of the Observatory to the President and Fellows of Yale College.

Digitized by Google

OBSERVATORY IN YALE COLLEGE.

BOARD OF MANAGERS.

Rev. NOAH PORTER, D.D., LL.D., *President.*
THOMAS G. BENNETT, PH.B., of New Haven.
JACOB CAMPBELL, ESQ., of New York.
Professor ELIAS LOOMIS, LL.D.
Professor CHESTER S. LYMAN, M.A,
Professor HUBERT A. NEWTON, LL.D., *Secretary.*

OFFICERS.

ROBERT BROWN, Jr., M.A., *Secretary.*
LEONARD WALDO, S.D., *Astronomer in charge of the Horological Bureau.*
ORRAY T. SHERMAN, B.A., *Assistant Astronomer.*
WILLIAM L. ELKIN, Ph.D., *Astronomer in charge of the Heliometer.*

Digitized by Google

REPORT.

GENTLEMEN:

The Horological and Thermometric Bureaus of the Observatory have been carried on during the past year under Dr. Waldo's direction. For the details of the work we refer you to his Report to us, which is herewith transmitted to you.

Mr. Wilson had charge of the time-service until October, when, to our serious loss, he withdrew from the Observatory, and went to Europe. Since October, Dr. Waldo has done this work. The photographs taken by Mr. Willson during the Transit of Venus have been placed in the hands of the Transit Commission at Washington for measurement.

In the Thermometric Bureau, Mr. Sherman has made the comparisons of thermometers throughout the year. For an account of his other scientific work we refer to his report herewith submitted.

Mr. Brown has prepared and has issued the certificates for instruments verified in the Bureaus, has kept the financial accounts of the Bureaus, and has superintended the work on the grounds of the Observatory reservation. Already these grounds show the results of his good taste and superintendence, and in coming years these results will be still more manifest.

Prof. Kershner has completed his computation for the determination of the scale values of the Heliometer from the observations of the stars η, 17 and 27 in the Pleiades, from those of the Cygnus-bogen, and from transits of α Tauri. The Heliometer observations of the Transit of Venus, made by Dr. Waldo and Prof. Kershner, have been reduced (by using the resulting scale value), so far as the equations of condition.

Prof. Newton continued in the discharge of his duties as Director until the acceptance of his resignation, May 8th.

The importance of having an observer whose whole time could be given to the Heliometer, and thus of making

Digitized by Google

a beginning in earnest of that kind of work for which Mr. Winchester gave to the Observatory his generous donation, has been long felt by us. We had a Heliometer of unsurpassed excellence, and it was due to the College, to the public, and to science, that the best possible use be made of it. This could be done only by an observer who had no other demands upon his time. The opportunity occurred in the later months of 1883, of securing the services of Dr. W. L. Elkin. He had given special study to the Heliometer at Strasburg, and for two years had had very valuable experience in the use of it in connection with and under the guidance of Dr. Gill, the Astronomer Royal at the Cape of Good Hope. To improve this opportunity a subscription was made by ten officers and friends of the Observatory of one hundred dollars each per year for three years, and Dr. Elkin was appointed by you for that period Astronomer in the Observatory in charge of the Heliometer. He entered upon his duties in January. His report of work done is herewith presented.

The following are the ten subscribers referred to:

Elias Loomis,	Class of	1830.
Richard S. Fellowes,	"	1832 (since deceased).
Henry C. Kingsley,	"	1834.
Morris W. Lyon,	"	1846.
Hubert A. Newton,	"	1850.
Robert Brown, Jr.,	"	1857.
Henry F. Dimock,	"	1863.
Levi C. Wade,	"	1866.
George T. Bliss,	"	1873.
Edward W. Southworth,	"	1875.

The grading of Caner Street is now nearly completed upon our portion of the street, and the lots fronting upon it are among the most attractive for residences in the city. The expense has been considerable, but a large fraction of it has been saved to the Observatory by reason of the demand for the material excavated.

The addition of the President of the College to the Board of Managers by your vote, May 18th, will, it is believed, result in good both to the Observatory and to the College. We think that he should have been a member of the Board from the beginning.

Digitized by Google

For additions to the Library of the Observatory we are indebted to the following persons:

The Director of the Observatory at Cambridge, Mass.
Washington.
Oxford (Radcliffe).
Dun Echt.
Neuchatel.
Ekaterinburgh.
Moscow.
Tacubaya.
Rio de Janeiro.
Secretaria de Fomento de la Republica Mexicana.
Chief Signal Officer, U. S. Army.
Superintendent of the American Ephemeris.
Lords Commissioners of the Admiralty.
Engineer in charge of the U. S. Geographical Surveys.
Canadian Institute, Toronto.
Philosophical Society, Washington.
Jewelers' Journal, Chicago.
H. Carrington Bolton.
Th. Bredichin.
J. D. and E. S. Dana.
Mrs. Henry Draper.
William D. Ely.
Edmund A. Engler.
A. Hirsch.
Victor Kremser.
E. K. Moore.
E. C. Pickering.

Respectfully submitted to the President and Fellows of Yale College.

By order of the Board of Managers,

H. A. NEWTON,
Secretary.

Yale College, June 19, 1884.

Digitized by Google

REPORT OF DR. WALDO.

To the Board of Managers:

Gentlemen—The present report refers to the work in the Horological and Thermometric Bureaus during the year ending May 31, 1884.

THE HOROLOGICAL BUREAU.

The methods of comparing time-pieces, and in general of conducting the work of the Bureau, continued the same as in the preceding year. The number of watches received from the makers since the commencement of the work of the Bureau is as follows:

1880–81	219
1881–82	53
1882–83	41
1883–84	87

It will be seen from the subsequent analysis of their performance that there has been a marked increase in the excellence of the movements submitted to our trials, which, so far as can be observed, is a direct result of the interest our work in this department has excited.

The duration of the trials and the positions during their rating of the watches submitted during the past year, are shown in the following table:

Test No.	Position.	Approximate Temperature.	Number of days trial for Class Certificates.			
			I.	II.	III.	IV.
1	Dial vertical, Pendant up	60° to 70° F.	7	8	8	12
2	Dial vertical, Pendant right	60° to 70° F.	2	2		
3	Dial vertical, Pendant left	60° to 70° F.	2	2		
4	Dial horizontal, Dial down	60° to 70° F.	2			
5	Dial horizontal, Dial up	60° to 70° F.	10	8	8	or 12
6	Dial horizontal, Dial up	34° to 38°	1	1	1	
7	Dial horizontal, Dial up	95° to 100°	1	1	1	
8	Dial horizontal, Dial up	60° to 70°	10			
9	Dial vertical, Pendant up	60° to 70°	7			
	Total number of days		42	22	18	12

Digitized by Google

The conditions excluding watches from certification continue as follows:

1. When the variation of rate with the dial vertical and pendant up in classes I., II., III., and in the positions indicated in class IV., exceeds $2^s.0$ from one day to the following day.

2. When the variation of rate between the positions of "Dial up" and "Dial vertical" exceeds $10^s.0$

3. When the variation for 1° F. exceeds $0^s.3$ between the ordinary temperature and the oven.

4. When the rate is greater than $10^s.0$ per day in any position.

The number of watches received, and certificates issued, during the year ending May 31, 1884, are as follows:

Entered for—		Of which—
Class I. certificates	57	42 received certificates Class I.
Class II. certificates	7	5 received certificates Class II.
Class III. certificates	3	3 received certificates Class III.
Class IV. certificates		19 received rate records.
Special rate records	20	None remain on hand, and 18 were returned to their senders as not fulfilling the necessary conditions for obtaining any certificate or rate record.
Total number received	87	

The following tables give abstracts of the performance of the individual watches receiving certificates during the year:

Digitized by Google

TABLE No. 2.—WATCH MOVEMENTS OBSERVED FOR TWENTY-TWO DAYS, IN FOUR POSITIONS, AND IN THE OVEN AND REFRIGERATOR, AND WHICH RECEIVED CLASS II. CERTIFICATES.

Rank.	Maker's Number.	Maker's Name.	Escapement.	Spring.	Mean daily rate.	Mean daily variation.	Variation for 1° Fahr.	Diff. between Pendant up and Dial up.	Diff. between Pendant up and Pendant right.	Diff. between Pendant up and Pendant left.	Diff. between extremes of rate.	Mark computed for			Total.	Recorded.
												Daily variation.	Position.	Temp.		
					s.	s.	s.	s.	s.	s.	s.					
1	1561683	American Watch Co.,...	Lever,..	Flat,..	+1.71	0.63	−0.02	−0.36	−0.86	+0.34	4.0	27.4	38.4	18.6	84.4	334
2	1561798	American Watch Co.,...	Lever,..	Flat,..	+0.62	0.50	+0.04	+1.60	+1.13	+3.98	6.7	31.2	35.4	17.3	83.9	341
3	1561614	American Watch Co.,...	Lever,..	Flat,..	−0.83	0.62	+0.09	−3.36	−3.64	−4.39	8.5	27.6	34.2	14.0	75.8	333
4	1560073	American Watch Co.,...	Lever,..	Flat,..	−0.41	1.06	+0.04	−5.34	−3.48	−4.98	8.6	18.8	33.1	17.3	69.2	331
5	1561615	American Watch Co.,...	Lever,..	Flat,.	−2.81	0.88	+0.17	+0.22	−3.19	−4.54	12.9	22.4	34.2	8.4	65.0	335

Received from, and adjusted by the American Watch Company, Waltham, Mass.

TABLE No. 3.—WATCH MOVEMENTS OBSERVED FOR NINETEEN DAYS, IN TWO POSITIONS, AND IN THE OVEN AND REFRIGERATOR, AND WHICH RECEIVED CLASS III. CERTIFICATES.

Rank.	Maker's Number.	Maker's Name.	Escapement.	Spring.	Mean daily rate.	Mean daily variation.	Variation for 1° Fahr.	Diff. between Pendant up and Dial up.	Diff. between extremes of rate.	Mark computed for.			Total.	Recorded.
										Daily variation.	Position.	Temp.		
					s.	s.	s.	s.	s.					
1	12320	Paul Breton, Geneva, ...	Lever,..	Breguet,...	−1.10	0.74	+0.12	−0.29	6.8	25.2	39.6	12.0	76.8	360
2	16444	H. R. Ekagren, Geneva,..	Lever,..	Breguet,...	+1.46	0.73	−0.08	−5.80	9.4	25.4	28.4	14.7	68.5	368
3	16150	H. R. Ekagren, Geneva,..	Lever,..	Breguet,...	−0.29	0.44	−0.12	+8.17	13.5	31 2	23.7	12.0	66.9	369

No. 1, received from Aiken, Lambert & Co., New York. Adjusted by H. H. Heinrich, N. Y.
Nos. 2, 3, received from Crosby & Foss, Boston. Adjusted by Horatio Towne, Boston.

Digitized by Google

Rank	Diff. bet. Pendant up and Pendt. right.	Diff. bet. Pendant up and Pendt. left.	Diff. Dial up and Dial down.	eived from
1	+0s.83	+ 0s.68	—1s.38	ch Co., Waltham, Mass.
2	+3.84	+ 2.99	+1.34	Co., New York.
3	+0.15	— 1.43	+2.76	ew York.
4	—1.67	+ 1.23	+2.39	ew York.
5	—3.35	— 3.00	+1.35	Haven.
6	—1.61	— 3.51	—2.02	ch Co., Waltham, Mass.
7	+0.91	— 2.24	+2.17	ch Co., Waltham, Mass.
8	+3.42	+ 1.77	—2.27	York.
9	—4.87	— 2.37	+0.16	yracuse, N. Y.
10	+8.49	+ 4.74	+0.47	Co., New York.
11	—1.62	— 1.72	—0.36	thez, New York.
12	—1.52	+ 1.73	—2.34	ch Co., Waltham, Mass.
13	—1.37	+ 1.53	+2.95	ch Co., Waltham, Mass.
14	+2.59	+ 4.21	+0.40	yracuse, N. Y.
15	—4.19	— 4.09	—1.42	Co., New York.
16	—0.23	+ 3.62	—8.83	ch Co., Waltham, Mass.
17	+1.68	+ 5.18	—0.28	Co., New York.
18	+6.12	— 0.83	—3.47	York.
19	—3.50	+ 8.85	+1.77	Co., New York.
20	+3.84	— 0.01	—0.07	thez, New York.
21	—6.72	— 1.87	—2.03	Co., New York.
22	—0.32	+ 1.23	+2.42	racuse, N. Y.
23	+4.27	+ 2.32	—3.35	thez, New York.
24	—2.34	— 3.94	+0.39	thez, New York.
25	—5.31	— 5.71	+1.45	yracuse, N. Y.
26	+0.71	+ 8.06	+2.68	ch Co., Waltham, Mass.
27	0.00	+ 2.60	—1.40	w York.
28	—0.27	+ 0.43	—2.41	ch Co., Waltham, Mass.
29	—3.05	— 1.30	—1.69	ch Co., Waltham, Mass.
30	—9.61	— 9.66	+0.35	Co., New York.
31	+0.08	+ 0.15	+1.34	Co., New York.
32	+0.31	— 6.04	—0.46	ch Co., Waltham, Mass.
33	—2.40	— 8.10	—1.21	Co., New York.
34	+5.91	+ 7.71	+1.70	thez, New York.
35	+5.83	— 3.17	+1.63	thez, New York.
36	+0.01	— 6.69	—1.92	Co., New York.
37	—6.39	+ 1.61	+4.36	Co., New York.
38	—4.32	—12 62	—0.70	Co., New York.
39	—2.76	—10.41	—0.94	w York.
40	+3.35	+ 3.95	—4.90	thez, New York.
41	+1.06	+ 0.96	+6.59	thez, New York.
42	+3.97	0.82	+4.21	thez, New York.

Digitized by Google

Digitized by Google

There have been received four marine chronometers, all of which are of the highest class of workmanship and are all provided with auxiliary compensations.

The performance of these chronometers under varying conditions of temperature is shown in the following tables:

SUM OF THE WEEKLY RATES OF FOUR MEAN TIME CHRONOMETERS RATED DURING MARCH, APRIL AND MAY, 1884.

Maker's name	H.H. Heinrich.		H.H. Heinrich.		H.H. Heinrich,		W. Bröcking, Hamburg.	
Maker's number	6		9		13		988	
Adjusted by	The maker.		The maker.		The maker.		The maker.	
Escapement	Chronometer.		Chronometer.		Chronometer.		Chronometer.	
Spring	Vertical spiral.		Vertical spiral.		Vertical spiral.		Vertical spiral.	
Balance	Heinrich's pat. auxiliary.		Heinrich's pat. auxiliary.		Heinrich's pat. auxiliary.		Auxiliary Compensat'on.	
Sum of daily rates:	Sum.	Temp.	Sum.	Temp.	Sum.	Temp.	Sum.	Temp.
1st week	0s.0*	67°	+ 6s.6*	36°	−3s.1	63° F.	+3s.1	60°
2d week	+3.1	36	+ 6.3	60	−4.3*	38	+4.1	58
3d week	−0.2	64	+14.6	58	+2.4	66	+5.2	65
4th week	+4.0	58	+11.9	65	+3.9	36	+5.7	67
5th week	+2.3	65	+ 9.6	66	+2.9	65	+4.7	66
6th week	+1.4	67	+ 5.8	66	+4.2	58	+4.4	67
7th week	+0.3	65	+11.1	70	+3.7	63	+4.1	67
8th week	−1.6	68			+6.0	66	+4.3	67
Mean weekly variat'n	1s.5		2s.7		3s.5		0s.4	
Recorded	374		375		370		376	
Received from	H.H. Heinrich, New York.		H.H. Heinrich, New York.		H.H. Heinrich, New York.		The Physical Laboratory of the U. S. Geological Survey.	

* Four day periods.

A tower clock, made by and received from the Seth Thomas Clock Company, of Thomaston, Conn., with dead beat escapement, varnished wood rod, steel spring suspension, and an iron cylindrical bob whose diameter and hight are about 135 and 310 millimeters respectively, was rated during two periods. Between the periods the rate was lessened by removing a small weight from the pendulum bob. The temperature

Digitized by Google

ranged between 55° and 77° F. The results are shown in the following table:

1st Period, Jan. 3d to Jan. 30th, 1884.			2d Period, Feb. 10th to March 17th, 1884.		
No. days.	Mean daily rate.	Variati'n of rate bet. successive intervals.	No. days.	Mean daily rate.	Variati'n of rate bet. successive intervals.
	s.	s.		s.	s.
10	+5.54		3	−0.33	
4	+5.43	+0.11	4	−0.32	−0.01
3	+5.45	−0.02	4	−0.18	−0.14
4	+6.56	−1.11	10	−0.50	+0.32
3	+6.21	+0.35	4	−1.12	+0.62
4	+6.28	−0.07	3	−1.00	−0.12
			4	−0.50	−0.50
			3	−1.50	+1.00

The following table gives a resumé of the watches certified during the past four years:

Year	1880–81.	1881–82.	1882–83.	1883–84.
Percentage of watch movements receiving certificates of any kind, excluding watches entered for rate records	45	38	28	77
Number receiving Class I. certificates	22	12	8	42
Average mark of Class I. certificates	68.8	68.6	76.4	74.4
Average mark of the first five watches receiving class I. certificates	79.4	77.0	80.4	85.8
Highest mark received during the year	83	82	85	90.4
Makers' name of watch receiving the highest mark during the year	American Watch Co. Waltham.	Barraud & Lunds, London.	Vacheron & Constantin Geneva.	American Watch Co. Waltham.

In preceding reports the desirability of altering the form of our watch trials has been pointed out. During the past year this subject has been under consideration by the superintendents of the observatories at Geneva, Switzerland, and of Kew, England, and by ourselves, with the result that an inter-

Digitized by Google

national system has been agreed upon, by which the trials at Geneva, Kew, and Yale will be strictly comparable.

I submit herewith the revised regulations for this Bureau necessary to carry this international scheme into practical operation so far as we are concerned. The scheme has been in operation for some years at the Geneva Observatory, and was announced in May of this year as adopted at the Royal Society's observatory at Kew.

REGULATIONS GOVERNING THE ISSUE OF CERTIFICATES OF RATES OF TIMEPIECES, AFTER OCTOBER 1, 1884.

I.—*Classes of Certificates.*

The following classes of certificates will be issued with timepieces which have been deposited at this observatory for trial:

The certificates will contain a detailed statement of the results obtained with each particular movement.

In describing the positions of a movement, the term "Dial up" indicates that the plane of the dial is horizontal, and with the engraved side uppermost. "Dial vertical" indicates that the plane of the dial is vertical.

The temperature of the refrigerator is approximately 40° F., that of the oven is approximately 90° F., and the ordinary temperature ranges between 65° and 75° F.

1. Class A includes those certificates issued with pocket chronometers or watches which have been subjected while rating to the following variations of position and temperature:

Period.	Occurs during the days of the trial.	Position.	Temperature.
First.	1st to 6th.	Dial Vertical, Pendant up.	Ordinary.
Second.	6th to 11th.	Dial Vertical, Pendant Right.	Ordinary.
Third.	11th to 16th.	Dial Vertical, Pendant Left.	Ordinary.
Fourth.	16th to 22d.	Dial up.	Refrigerator.
Fifth.	22d to 28th.	Dial up.	Ordinary.
Sixth.	28th to 34th.	Dial up.	Oven.
Seventh.	34th to 40th.	Dial down.	Ordinary.
Eighth.	40th to 45th.	Dial Vertical, Pendant up.	Ordinary.

Digitized by Google

The trial comprises forty-five days, during which the movement is rated in five positions during periods of five days each, and is exposed to cold, warm, and average temperatures. In order that the movements may assume their new rates under changed conditions, the first day's rating in the 4th, 5th, 6th, and 7th periods are not used in making up the record of a movement's performance.

2. Class B includes those certificates issued with pocket chronometers or watches which have been subjected while rating to the following variations of position and temperature:

Period.	Occurs during the days of the trial.	Position.	Temperature.
First.	1st to 15th.	Dial Vertical, Pendant up.	Ordinary.
Second.	15th to 29th.	Dial up.	Ordinary.
Third.	29th to 30th.	Dial up.	Refrigerator.
Fourth.	30th to 31st.	Dial up.	Ordinary.
Fifth.	31st to 32d.	Dial up.	Oven.

3. Class C includes those certificates issued with pocket chronometers or watches which have been subjected while rating to the following variations of position and temperature.

Period.	Occurs during the days of the trial.	Position.	Temperature.
First.	1st to 9th.	Dial Vertical, Pendant up.	Ordinary.
Second.	9th to 17th.	Dial up.	Ordinary.

Certificates of the classes A, B, and C are issued in two grades. The ordinary certificate is issued when the observed ratings show that an excellence has been attained which is within the limits assigned in the third column of the following table and the certificates have the words "especially good" attached to them by the officer signing the certificate, when a degree of excellence has been attained within the limits shown in the fourth column.

Digitized by Google

Class.	Condition.	Col. III.	Col. IV.
A.	When the mean difference of the daily rate under the same condition of temperature and position, and during the same period, does not exceed	2.ˢ00	0.ˢ75
B.	do. do.	2.00	0.75
C.	do. do.	2.00	0.75
A.	When the difference between the mean daily rate, Pendant up, differs from the mean daily rate, Dial up, by less than	5.ˢ00	2.ˢ50
B.	do. do.	10.00	5.00
C.	do. do.	10.00	5.00
A.	When the difference between the mean daily rate, Pendant up, and the mean daily rate in any position except Dial up is less than	10.ˢ00	5.ˢ00
A.	When the variation for 1° F. does not exceed	0.30	0.15
B.	do. do.	0.30	0.20

In addition to the above described certificates there will be furnished records of rate for any timepieces deposited at the Observatory for such a purpose. These records are meant to indicate the performance of timepieces, and may take any form the person desires who enters the timepieces, subject to the approval of the officer in charge. When such timepieces are box chronometers, and they have been rated for a minimum period of two months, and have been rated in the refrigerator and in the oven, and there has been no daily variation greater than $2^{s}.0$ or than $0^{s}.3$ for 1° F., certificates of the class D will be issued with them.

When such a timepiece is a clock, and it has been rated for a minimum period of three months at ordinary temperatures, and has been tested for compensation in temperature, and when the daily variation of rate has not exceeded $1^{s}.0$, except there has been an attendant variation of the barometer in its case as great as $0^{in}.70$, and when the variation for 2° F. has not exceeded $0^{s}.30$, a certificate of the class E will be issued with it.

Digitized by Google

II.—*Cost of Certificates.*

Designation.	Observatory charge.	Remarks.
Certificates:		
Class A.	$7.50	Discount of one-third when five movements are rated at the same time.
Class B.	5.00	do. do.
Class C.	3.00	do. do.
Class D.	7.50	do. do.
Class E.	20.00	An additional charge for clock mounting will be made depending on its cost.
Rate records.	Per diem, $0.10	An additional entrance fee of $0.25 will be charged for each movement.

The experiment is being made of converting the clock Bond 367 into a clock of the highest grade of precision. For this purpose it has been re-mounted in a heavy cast-iron case, and hung between two brick piers. Arrangements have been introduced in it for the control of the pressure and the chemical constitution of the enclosing medium in which the pendulum swings.

The establishment of a clock of precision in this Bureau is of the greatest importance, since we are sometimes required to give daily rates of timepieces for a period comprising a week of continuously cloudy weather.

The Hillhouse clock has been cleaned, repaired, and adjusted to sidereal rate.

The clock Howard 191 has given us a considerable amount of trouble in transmitting the time signals. The successful transmission of time signals requires that the transmitting clock shall be an accurate timepiece, and yet that at the same time it shall be able to do the additional work of actuating electrical devices.

In the case of the Howard clock, the electrical apparatus is without that capacity for accurate and delicate adjustment which every telegraph instrument designed for continued use over long lines should possess; and although the devices employed in this clock are as efficient as any which have yet

Digitized by Google

come under my notice by other makers, yet one of the first needs of the Bureau is an alternative mean-time distributing clock fitted with electrical time signal distributing apparatus, constructed from the standpoint of the telegraph engineer, rather than from that of the clock maker.

Our present time signal clock has been thoroughly repaired and cleaned, adjustable contact springs have been inserted, and our time signals will be distributed during the coming year more satisfactorily than during the past, but it is unsafe to have the State Time Service dependent on this one clock.

Observations for time were made on the number of nights set opposite the months following:

1883, June	19.	December	13.
July	23.	1884, January	11.
August	24.	February	9.
September	22.	March	14.
October	19.	April	13.
November	13.	May	11.

The observatory public time signals were changed on Nov. 18, 1883, from the local time of the City Hall meridian, New York, to that of the seventy-fifth meridian west from Greenwich, to accord with the general action of the railroads and cities of the Eastern States. This move in the direction of public convenience had been urged from the organization of our Bureau. The original establishment of a meridian of New York City as a State time, was with the ultimate object of making as much of a change toward the seventy-fifth meridian time, as the public sentiment at the time of the passage of the first time-law by the Legislature would allow. At the January session of this year the Legislature amended the time law to make legal the seventy-fifth meridian or "Eastern Time" now in use.

The work of the Horological Bureau continued under the charge of Mr. R. W. Willson up to October, 1883, after which time it devolved upon the writer. In Mr. Willson's departure, the Bureau lost an officer of marked ability in the work in which the Bureau is engaged.

Digitized by Google

The Thermometric Bureau.

A larger number of thermometers than in any preceding year has been received for examination.

There has been a total of 6,390 thermometers examined, as follows:

17 Standard thermometers.
8 High temperature thermometers.
1 Minimum meteorological thermometer.
2 Maximum meteorological thermometers.
1 Thermometer below 0° F.
28 Ordinary meteorological thermometers.
6326 Physicians' clinical thermometers.
4 Thermometers to be pointed.
3 Thermometers to have the index restored.

There were also received for examination 9 hydrometers and 2 barometers. Of the above, 29 thermometers were broken in transit to the Observatory and 5 were broken during examination. As compared with our preceding year's work in this department, we have for the years given below:

Year	1880-81.	1881-82.	1882-83.	1883-84
Physicians' thermometers examined,	1667	3811	5140	6326
Other thermometers examined,	290	741	155	64
Total number instruments,	1957	4552	5295	6390

The verification work of this Bureau has been conducted as usual by Mr. O. T. Sherman, and the Secretary, Mr. Robert Brown, has issued the certificates and conducted the correspondence.

Respectfully submitted,

LEONARD WALDO,
Astronomer in charge of the Bureaus.

Digitized by Google

REPORT OF MR. SHERMAN.

YALE COLLEGE, June 9, 1884.

GENTLEMEN:

Besides the routine work in the Thermometric Bureau, I have during the past year devoted time and labor to the following subjects:

1. I completed the outfit and mounting of my pendulum. Observation with this has, however, been intermitted since January.

2. From Sept. 5th to Feb. 5th, I followed the comet Pons-Brooks, securing a long series of observations upon its form, polarization, and position. These observations have been only partially reduced.

3. The Observatory received near the end of December the magnetometer and dip-circle, which we owe to the generosity of W. D. Ely, Esq., of Providence. They are both of the Kew pattern. The constants of these instruments have been worked out, and a considerable number of observations taken. Those with the magnetometer are confined to the Observatory grounds, those with the dip-circle, thus far, to the vicinity of New Haven.

The following are the results of the magnetic observations at the observatory:

Date, 1884.	Declination.	Hon. force in C. G. S.	Dip.
January,	8° 54.′6 W.	0.17901	
February,			72° 51.′6
March,	50. 7 W.	0.17827	
April,	54. 1 W.		
May,	44. 1 W.	0.17829	
Total,	8° 50.′9	0.17852	72° 51.′6

The values for January and April are the means of observations on two dates. The others are single observations.

On July 17, 1878, Prof. T. E. Thorpe found, at a place not far removed, the values: 8° 40.′6 W.: 0.17802: and 73° 5.′8.

4. At Dr. Elkin's request a series of the measures of the diameter of Venus has been commenced.

5. The observations taken during the Transit of Venus, Dec. 6, 1882, await a final revision before being ready for the press.

Respectfully,

ORRAY T. SHERMAN,

Assistant in the Observatory.

To the Board of Managers of the Observatory.

Digitized by Google

REPORT OF DR. ELKIN.

YALE COLLEGE, June 13, 1884.

To the Board of Managers of the College Observatory:

GENTLEMEN: I beg leave to present the following statement of work with the Heliometer:

The instrument has been in my charge since January 15, 1884. I found it in good order, and both its mounting and that of the dome have proved most satisfactory.

The principal lines of investigation to which attention has been directed, are as follows:

1. The triangulation of the Pleiades. The interest attaching to this work will lie both in the new and independent determination of the relative positions of the stars of this important zodiacal group and in the comparison with the similar determination made with the Königsberg Heliometer nearly half a century ago, as well as with the later Paris results. The plan adopted will furnish, it is hoped, trustworthy tests of the reliability of the instrument both for absolute and relative distances and angles of position. From February 24th, the date of the arrival of the reversing eye-pieces from Messrs. Repsold, to April 12th, after which the stars are lost in the sun's rays, about one-third of the proposed plan has been accomplished. As the group will come into favorable position for observation during the last four months of the year, there is, therefore, all reasonable hope to finish the work during that time.

2. A considerable amount of time has been devoted to the determination of places of the moon relative to stars within measuring reach of the Heliometer. The principal object in view is the determination of the parallactic inequality in the moon's motion, the deduction of which from meridian and other observations is, as is well-known, attended with some difficulty.

3. Advantage has been taken of the favorable opportunity afforded by the approaching inferior conjunction of Venus for a series of observations on the diameter of this planet, of which a number have been already secured.

Digitized by Google

4. The general investigation of the instrument has been in progress. Its equatorial adjustments, flexures, etc., have been repeatedly determined, the screw of the scale micrometer examined, and the latter has been altered with a view to the best determination of the errors of the scales.

The reductions of the observations have not been carried beyond the preliminary stage, on account of the unavoidable want of some of the elements of reduction. Most of the results have, however, been taken out roughly to ensure confidence in the instrument's remaining in good working order.

Respectfully,

W. L. ELKIN,

Astronomer in charge of the Heliometer.

Digitized by Google

Digitized by Google

Educ R5603.1.5

Sci 772.5
4

REPORT FOR THE YEAR 1884–5, PRESENTED BY THE BOARD OF MANAGERS OF THE OBSERVATORY TO THE PRESIDENT AND FELLOWS OF YALE COLLEGE.

Digitized by Google

OBSERVATORY IN YALE COLLEGE.

BOARD OF MANAGERS.

Rev. NOAH PORTER, D.D., LL.D., *President.*
THOMAS G. BENNETT, PH.B., of New Haven.
JACOB CAMPBELL, ESQ., of New York.
Professor ELIAS LOOMIS, LL.D.
Professor CHESTER S. LYMAN, M.A.
Professor HUBERT A. NEWTON, LL.D., *Secretary.*

OFFICERS.

ROBERT BROWN, Jr., *Secretary.*
LEONARD WALDO, S.D., *Astronomer in charge of the Horological Bureau.*
ORRAY T. SHERMAN, B.A., *Astronomer in charge of the Thermometric Bureau.*
WILLIAM L. ELKIN, Ph.D., *Astronomer in charge of the Heliometer.*

Digitized by Google

REPORT.

To the President and Fellows of Yale College:

GENTLEMEN:—We submit herewith the reports of the Secretary and the Astronomers of the Observatory. These reports explain in detail the work done by the several officers during the past year.

Very respectfully,

THE BOARD OF MANAGERS,

of the Observatory in Yale College.

YALE COLLEGE, June 22, 1885.

REPORT OF MR. ROBERT BROWN, JR.

YALE COLLEGE, June 17, 1885.

To the Board of Managers:

GENTLEMEN:—I have the honor to report that during the year ending June 1st, 1885, the improvement of the Observatory grounds has progressed as favorably as our restricted resources would permit.

Canner street, for a distance of six hundred feet East from Prospect street, has been graded to a depth of 2–5 feet below the natural grade, and the grounds abutting on each side have been sloped conformably to the cut, and in accordance with

Digitized by Google

your instructions, and the slopes seeded with grass. Elm trees have been planted on the north side, for the above named distance, or as far as is practicable until the bank on the steeper part of the street, east of the proposed extension of Hillhouse Avenue, shall have been reduced. The south side of this street for about 1000 feet east from Prospect street, and the east side of Prospect street, south from Canner street, had been similarly planted the previous year. The principal expense entailed by the grading of the above named portion of Canner street, was comprised in the necessitated resetting of the skeleton fences to the new level, and the smoothing and seeding of the disturbed ground. The holes for the trees were excavated and the trees themselves furnished as part consideration for the earth allowed to be removed.

A concrete sidewalk has been laid on the south side of Canner street for a distance of about 415 feet eastward from the proposed line of Hillhouse Avenue extension, which was as far toward St. Ronan street as the imperfect filling of Canner street at that point would permit, and for the same distance the gutter has been cobble-stoned on the south side.

The City has taken the preliminary steps toward sewering Canner street from Whitney Avenue to the proposed extension of Hillhouse Avenue.

Two fires this Spring have considerably damaged the young growth of trees and shrubs near Highland street, and it seems very desirable that the fence be continued around the entire lot,—through Prospect, Highland and St. Ronan streets,—for which most of the requisite cedar posts are on hand.

A considerable number of small trees have been transplanted from the adjoining undergrowth into the Observatory lot proper,—Beeches, Oaks of three species, Tulip trees, Dogwood, Sugar and Swamp Maples, Ash, Sassafras, etc., nearly all of which are doing well. The severe ice-storm of the winter of 1883–4 seriously damaged many of our forest trees, and to save them it became necessary last year to procure the services of an expert tree-pruner for their preservation, and with very satisfactory results. The ravages of insect and fungous enemies upon a few of our finer trees have been checked, with a promise of complete recovery in a few years. Two trees—chestnuts--were killed by lightning, on the northern portion of our grounds, last summer.

Digitized by Google

For contributions to the Library of the Observatory, we are under obligations to the following institutions and persons:

The Directors of the following Observatories:—
Observatoire Royale de Bruxelles.
Observatory of Trinity College, Dublin.
Lord Crawford's Observatory, Dun Echt.
Royal Observatory, Greenwich.
Harvard College Observatory.
Observatorio Meteorológico Magnetico Central de Mèxico.
Observatoire Cantonal de Neuchâtel.
Radcliffe Observatory, Oxford.
Real Osservatorio di Palermo.
K. K. Sternwarte im Prag.
Kaiserl. Nicolai-Hauptsternwarte, Pulkowa.
Observatoire Impérial de Rio de Janeiro.
Observatorio Nacional de Santiago de Chile.
Observatorio Astronómico Nacional de Tacubaya.
Leander McCormick Observatory, University of Virginia.
Astronomical Observatory, Utrecht.
U. S. Naval Observatory, Washington.
Secretaria de Fomento de la República Mexicana.
Chief Signal Officer, U. S. Army.
Superintendent of the American Ephemeris.
Lords Commissioners of the Admiralty.
U. S. Coast and Geodetic Survey.
U. S. Naval Academy.
Königl. Preuss. Geodätische Institut.
Physikalisch-ökonomischen Gesellschaft zu Königsberg.
Library of the University of Cambridge.
Canadian Institute.
International Electrical Exhibition, Philadelphia.
J. D. and E. S. Dana.
E. C. Pickering.
H. A. Newton.
L. Waldo.
Wm. L. Elkin.
R. Brown, Jr.
Wm. W. Payne.
Jeweler's Circular and Horological Review, New York.
Jeweler's Journal, Chicago.
Julius Wanschaff.
James W. Queen & Co.
H. Sotheran & Co.
Ulrich Hoepli.

Very respectfully,
ROBERT BROWN, Jr.,
Secretary of the Observatory.

Digitized by Google

FIFTH ANNUAL REPORT

OF THE

ASTRONOMER IN CHARGE OF THE HOROLOGICAL BUREAU OF THE OBSERVATORY IN YALE COLLEGE, 1884–1885.

PRESENTED TO THE BOARD OF MANAGERS AT THEIR MEETING, JUNE, 1885, BY LEONARD WALDO.

To the Board of Managers:

GENTLEMEN—The present report refers to the work of the Horological Bureau during the year ending May 31, 1885.

The methods of comparing the time-pieces continue in general the same as during the preceding year. The system of watch trials is, with some unimportant variations in details, that recommended in my last annual report, and agrees with the scheme adopted at the Kew Observatory, England, and the Observatory at Geneva, Switzerland.

Owing to the necessary absence of the observer who conducts the time-piece ratings, there have been no trials brought to a conclusion in time for this report, and the usual tables of ratings are therefore omitted. For the reason referred to, the reception of time-pieces during the latter months of the year was discouraged, with the result that not so large a number of time-pieces as usual have been received. The number of time-pieces received as compared with the number in previous years is as follows:

1880–81	219
1881–82	53
1882–83	41
1883–84	87
1884–85	58

The experiments relating to the establishment of a clock of precision for our watch-rating standard have been continued

Digitized by Google

in the case of clock "Bond 367," and the results of our experience in the matter are being embodied in the new clocks of precision now approaching completion at the works of one of our leading clock companies.

An entirely new and very satisfactory mercury cup relay for securing the transmission of our time signals has been devised. By means of this relay, the length of the time signal break can be adjusted to the greatest nicety, and failures of the signal from imperfect relay contacts are completely avoided. An elaborate, self-regulating-in-temperature watch-rating apparatus has been sent to the Bureau by one of its friends, and will be presented to the Bureau after any changes suggested by its use have been made in its construction.

Two other friends of the Bureau have signified their intention of presenting to the Bureau a new clock of precision, as soon as the necessary plans for its construction have been agreed upon, and the standard clock can be constructed.

In December, the Transit instrument was dismounted and the wooden casing surrounding the piers removed. The brick piers were then coated with Portland cement, with the result that the azimuth and level have been much more constant since the change.

A collimator, consisting of an uncorrected lens of 267.1 feet focal length, through which a brass screw head set in a brick pier to the south of the Transit instrument may be viewed, has been erected.

The level, having been taken apart, without result, to see whether there was no way by which its bubble length could be shortened, has had its division value redetermined. This value was found to be

$$0.''98365 = 0.^{s}067104.$$

in December, 1884, at about 65° F.

Time observations were made on the following number of nights for each month during the year:

June,	9	December,	9
July,	11	January,	12
August,	12	February,	16
September,	20	March,	14
October,	8	April,	6
November,	9	May,	6

Digitized by Google

A serious deficit in the finances of the Observatory is threatened by the sudden termination on the part of the State Legislature of the contract by which the Observatory has been paid for its Time Service to the State at large. The Joint Standing Committee on Appropriations reported to the House of Representatives on March 5, 1885, the bill by which this contract was practically terminated.

The report was made without a hearing at which any of the following interests at stake had been heard from; viz: The Railroad Commissioners who proposed the law and the contract originally; the clock and watch manufacturers; the mayors, or other public officers of the cities of the State; the Telephone and Telegraph Companies; the Observatory.

There were no reasons assigned in the debates which preceded the final success of the bill, other than those of economy to the State, as to why the service should not be continued, at least until the Observatory, which had gone to very considerable expense in preparation for this service, had been properly reimbursed for its outlay. It is hoped that the next legislature will reconsider the action on this subject and continue a State Time Service which so far has received only words of commendation.

Respectfully submitted,

LEONARD WALDO,

Astronomer in charge of the Horological Bureau.

Digitized by Google

REPORT OF MR. SHERMAN.

YALE COLLEGE, June 1, 1885.

To the Board of Managers of the Observatory in Yale College:

GENTLEMEN: During the year from June 1, 1884, to June 1, 1885, the Thermometric Bureau has been called upon to examine and report upon the following instruments:

Clinical Thermometers,	5580
Meteorological Thermometers,	57
Physical Standards,	22
High Temperature Thermometers (100° to 300° C.),	20
Low Temperature Thermometers (0° to − 40° C.),	6
Pointing,	4
Index restored,	5
Thermometers sealed for seasoning,	224
Hydrometers,	2
Total (omitting the thermometers sealed),	5696

During this interval nine thermometers have been broken in handling, and twenty-one have been received broken. The decrease in the sum total, as compared with that for the preceding year is due to the general depression in business. The circular generally issued,* the property list, and a financial statement are appended.

In October last, when placed in charge of the Bureau, it was made a part of my duty to conduct especial investigations of a scientific character. Outlines of four such investigations were deposited with your Secretary. Two of these have been brought to a stage where it is possible to show some result.

A STUDY ON THERMOMETERS INTENDED TO MEASURE TEMPERATURES FROM 100°—300° C.†

It is well known that when a thermometer is heated above a certain point, the mercury column is permanently displaced with regard to the scale.‡ The position of the point depends upon the constitution of the glass forming the bulb, and upon the previous use of the thermometer. For certain glasses

* The circular will be sent to any address on application.

† See also Amer. Jour. Sci., July, 1885.

‡ Transactions of the Royal Soc., Edin. Vol. xxix, Pt. II.

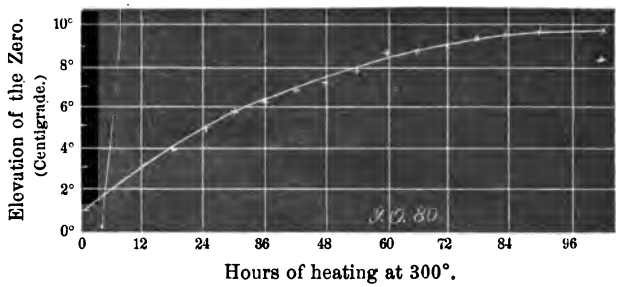
Digitized by Google

designated by the thermometer maker as German or American soda, and Cornish, the elevation upon a new thermometer begins at 111°. For a flint or crystal tube the point is nearer 200°. Mills records 256° as his highest observed limit, 48° as his lowest. Our experience presents nothing lower than 110° nor higher than 255°. The latter point is obtained with English flint or French crystal.

By much use or long heating the displacement frequently amounts to ten degrees Centigrade, and may amount to twenty-six degrees.* To assign corrections to points so easily displaced is evidently nugatory. The Observatory has therefore hitherto confined its corrections to points below that at which the ascent began.

If now the thermometer be exposed to a high temperature for some hours the successive positions of the ice point will be found to arrange themselves in a curve similar to that in

1.



the adjoining figure. Thus for the first eighteen hours during which the thermometer Y. O. 80 was held at 300° Centigrade, the zero point was elevated 3°; for the second eighteen hours the elevation was 2°.2, for the succeeding periods 1°.7, 1°.1, 0°.8, 0°.3, respectively. The elevation evidently becomes less and less, and the curve becomes more nearly parallel to the axis of abscissas.† This same thermometer placed in a bath of 200°, immediately after the last observation rose two-tenths of a degree in the first twelve hours, but no change was detected in the following hundred and eight.

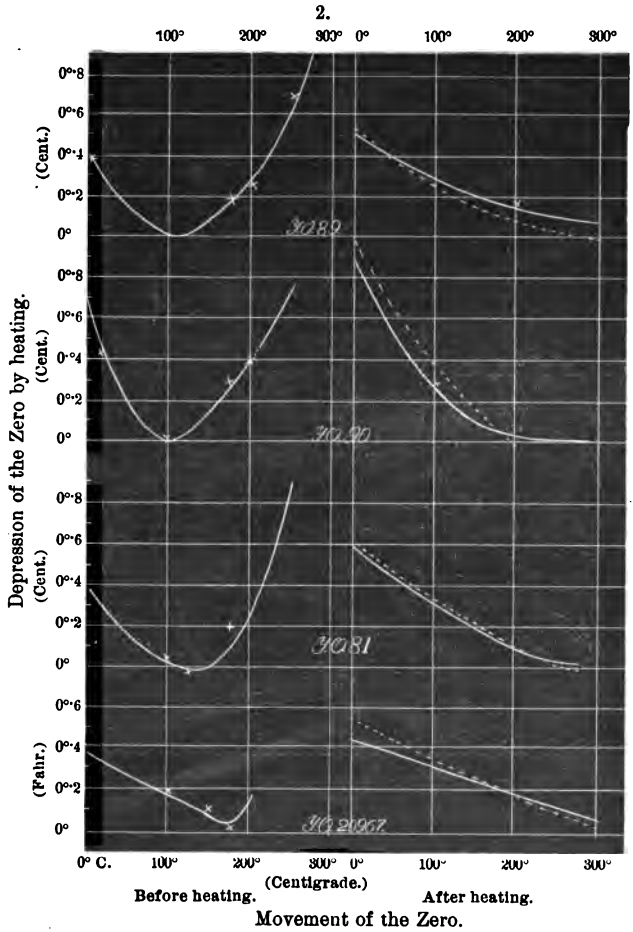
The question presents itself, What is the behavior of the thermometer after such treatment? First as regards the action

* Crafts, Comptes Rendus, 1882, 1883.

† Weber, Metronomische Beitrage. No. 3.

Digitized by Google

of the zero. In the adjoining cut we have compared the motion of the zeros of four thermometers before and after treatment. In the first series the influence of the rise is evident. The second is free therefrom. The movement of the zero for higher temperatures is similar to that for lower. That is, the mere fact of heating the thermometer now produces no distortions from which the instrument will not sensibly recover.



Movement of the Zero.

Does the instrument after treatment repeat its readings when exposed to similar conditions? Do its indications vary in time? We have observed the corrections to the following

Digitized by Google

treated thermometers on Feb. 16, March 9, and 22, and April 15. The record is given in the adjoining table.

	Feb. 16.	March 9.	March 22.	April 15.	Feb. 16–April 15.
		Y. O. 81 (Cent.)			
0°	−6°.6	−6°.6	−6°.6.	−6°.5	
100°	−5.85	−5.78	−5.76	−5.68	−0.16
200°	−6.3	....	....	−6.1	
		Y. O. 89 (Cent.)			
0°	−5°.5	−5°.5	−5°.5	−5°.5	
100°	−4.3	−4.0	−4.1	−4.0	−.01
200°	−5.3	....	....	−5.1	
		Y. O. 90 (Cent.)			
0°	−8°.9	−8°.9	−8°.6	−8°.5	
100°	−6.8	−7.0	−7.0	−6.9	−0.06
200°	−6.3	....	....	−6.4	
		Y. O. 20967 (Fahr.)			
0°	−16°.8	−16°.9	−16°.9	−17°.0	
212°	−18.8	−18.4	−18.6	−18.5	
387°	−25.2	−25.2	....	....	+0.17
420°	−27.8	....	....	−28.2	

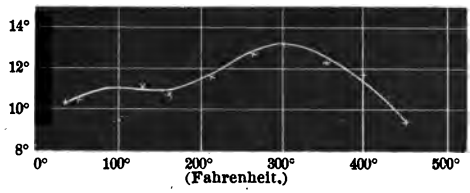
On all of these instruments the closeness of the graduation renders an error of observations of a tenth not improbable, so that with one exception, there is no difference which seems worthy of remark. These observations indicate that after treatment the thermometer is as serviceable as a measure of temperature ranging from 0° to 300° C. as the standard to which we are accustomed is for the range 0° to 100°. In the curve representing the movement of the zero, the record of April 15 is represented by a dotted line, that of February 16 by the full line. The former are slightly more curved than the latter. Again, in the final column of the preceding table are given the mean differences between the corrections due on Feb. 16 and April 15. Both of these differences we would interpret as small effects still occurring in the bulb, such as happen in every new thermometer, rather than as evidence that the instrument does not repeat itself.

It is of interest to ask what is the nature of the change which has been effected in the glass. If we compare the errors before and after treatment we obtain the following differences.

	Y. O. 81.	Y. O. 89.	Y. O. 90.
0°	4°.0	4°.9	7°.5
100°	2°.8	2°.9	6°.6
200°	4°.6	4°.0	4°.4

Digitized by Google

The differences for Y. O. 20967, upon which the points of comparison are more frequent, are given in the adjoining curve.



These differences indicate a change in the co-efficient of expansion of the glass. The amount for the interval 0°–100 is readily calculated and presents us with the following values:

Y. O. 81,	$100\,\delta\beta =$	−0.000046
Y. O. 89,	$=$	−0.000022
Y. O. 90,	$=$	−0.000003
Y. O. 20967,	$=$	+0.000026

Values similar to the first two have been previously observed by Weber, and by Crafts. The latter two are, as far as my knowledge goes, without precedent.

Again, if the thermometer be preserved at ordinary temperatures, similar changes occur. We may instance the elevation of the zero with time. Its law is similar to that of the elevation produced by heating. Or, analogous changes ocour in the variation of the fundamental length-interval and the coefficients of expansion.

All of these facts—the condensation of the material forming the bulb; the consequent increase of its intermolecular attraction, the dependence of the point at which the zero begins to rise upon the chemical constitution of the glass, the similarity of the changes produced by time, the regularity of these changes, seem to indicate that the cause for the one, as was long since suggested for the other, is a partial separation of the crystalline from the amorphous bulb-constituents. If this view is correct, it argues well for the stability of the treated instrument. The change will have been produced at the expense of its natural life. But then, few thermometers are permitted to die of old age.* The correctness of this view is the subject of a separate research.

The greater portion of the thermometers now offered in the

* Since writing the above I have been informed by a maker that the way to make thermometers good is to keep them in salt and ice for a long while.

Digitized by Google

market are affected by this error. It is believed that an Observatory certificate that a thermometer has been freed therefrom will have value. It is therefore proposed to undertake at the Observatory, for a moderate charge, the necessary treatment of thermometers sent to us for that purpose.

BEHAVIOR OF THE THERMOMETER WHILE SUFFERING A CHANGE OF TEMPERATURE.

A second investigation undertaken in accordance with the outline submitted to you upon taking charge of the Bureau, consists of an analysis of the state of the thermometer while suffering a rapid change of temperature.

The thermometer is essentially an instrument for comparing constant thermal conditions. In many cases, however, the physicist finds it of importance to observe an instantaneous and changing temperature; as, for instance, in investigating the law of cooling or the discussion of observations with Violle's exposed bulb. In such cases the changing is treated as though it were a static reading. Such a reading is, however, disturbed both by distortion of the bulb and by the friction of the mercury upon the glass. It has seemed not out of place to attempt to interpret the instantaneous reading.

If a thermometer be plunged into a bath whose temperature is very different from its own, its initial is in the direction contrary to its final motion. If the bulb be of such dimensions that its parts receive the heat practically simultaneously, and if its scale be open, the effect becomes evident to the naked eye. In two thermometers which we have especially examined, F. G. Greiner 600 and F. G. Greiner and Geissler 536*b*, the depression for a difference of temperature of 47° C. amounts to 0°.90 C. and 0°.73 C. respectively. The record is given in the adjoining table:

Diff. of Temp.	600.		536*b*.	
	Depression.	Elevation.	Depression.	Elevation.
47° C.	−0°.90	....	−0°.73	+1°.04
40	−0 .75	....	−0 .70	+0 .88
30	−0 .50	+0°.47	−0 .55	+0 .64
20	−0 .29	+0 .32	−0 .32	+0 .37
10	−0 .14	+0 .30	−0 .16	+0 .27

If the circumstances are such that the bulb is exposed slowly, or if only a portion thereof receives heat at once, the effect will be disguised and the column may appear stationary.

The reason is evident: the glass being heated or cooled

Digitized by Google

before the mercury, the volume of the bulb is greater or less than the volume corresponding to the temperature of the mercury. We have chosen an exagerated case, but as long as the thermometer is rising or falling a similar condition must exist.

Again, if a thermometer with very small bore be taken from a constant temperature, allowed to rise slightly, and replaced in the bath the reading will continue slightly too high. Perhaps, however, the effect of friction is most strikingly shown by comparing the times at which the column passes each fifth degree upon sudden immersion.

For falling temperature,	2s.36	4s.54	9s.39	33s.09
For rising temperature,	2 .31	4 .16	7 .57	15 .52

The question before us, then, is whether it is possible to derive from the disturbed reading the temperature of the glass, the temperature of the mercury and the effect of friction.

If we represent by τ_o the apparent temperature, by τ_g the temperature of the glass, by τ_m the temperature of the mercury β, the coefficient of expansion of the glass, γ the coefficient of expansion of the mercury, F and F′ the corrections depending upon friction, we have at once from the theory of the thermometer; for a rising temperature,

$$\tau_o = \tau_m - \frac{\beta}{\gamma}(\tau_g - \tau_m) - \mathrm{F},$$

for a falling temperature,

$$\tau_o = \tau_m + \frac{\beta}{\gamma}(\tau_m - \tau_g) + \mathrm{F}'.$$

When the temperature of the mercury remains constant and the glass changes, the value of the depression or elevation is given by

$$\tau_o - \tau_m = \pm \frac{\beta}{\gamma}(\tau_g - \tau_m).$$

If, now, we consider that the depression takes place only while the heat is making its way through the glass, and that the moment of turning marks the moment of accession of heat to the mercury, we are in a position to measure the temperature of the glass when the flow of heat commences. Again, assuming that the several ordinates of the curve which express the variation of temperature in the glass are proportional to the differences of temperature at the two sides of the glass, we may express its instantaneous temperature by

Digitized by Google

$$\tau_g = \tau_m + (u - \tau_m)\int \frac{\tau x\, \delta x}{D} = \tau_m (1 - c) + uc,$$

where u represents the final reading of the thermometer and $\tau_m + c$ the mean temperature of the glass for a difference of temperature of 1°.

In the case before us $u = 26°.636$ R and 0° R, and assuming $\beta = 0.0000214$, $\gamma = 0.0001814$, we readily have

$\tau_o = -0°.46$ R	$\tau = {}_m 0°$	$\tau_g = 3°.23$	$c = 0°.147$
$\tau_o = 26°.93$ R	$\tau_m = 26.50$	$\tau_g = 3°.67$	$c = 0°.138$

Replacing the value τ_g by its expression in terms of τ_m, as given above, we readily obtain; for a rising temperature,

$$\tau_m = \frac{\tau_o}{1 + \frac{\beta}{\gamma} c} + \frac{cu \cdot \frac{\beta}{\gamma}}{1 + \frac{\beta}{\gamma} c} + \frac{F}{1 + \frac{\beta}{\gamma} c},$$

for a falling temperature,

$$\tau_m = \frac{\tau_o}{1 + \frac{\beta}{\gamma} c} + \frac{cu \cdot \frac{\beta}{\gamma}}{1 + \frac{\beta}{\gamma} c} - \frac{F'}{1 + \frac{\beta}{\gamma} c},$$

which in the present case gives us readily

$$\tau_m = \frac{\tau_o}{1.0173} + 0.46 + \frac{F}{1.0173},$$

$$\tau_m = \frac{\tau_o}{1.0162} - \frac{F'}{1.0162}.$$

From a series of such equations derived under similar conditions from thermometers suited to give a series of values of F and F′, or from a series where F and F′ are varied by the varying position of the thermometers, we would be able to directly observe the law of cooling, or, assuming Dulong and Petit's well known expression, we would be able to separate the effect of friction from the observed values. An example derived from the latter assumption follows, though accuracy lies not therein:

Thermometer Rising.					Thermometer Falling.				
Time.	τ_o	τ_m	τ_g	F	Time.	τ_o	τ	τ_g	F
0ˢ.	0°	+0.46	4°.30	0°.00	0ˢ.	25°	24.60	20°.54	0°.00
1ˢ.006	5°	5.37	8°.49	0°.00	0ˢ.87	20°	19.64	16°.40	+0°.04
2ˢ.311	10°	10.32	12°.71	0°.03	2ˢ.23	15°	14.09	12°.02	+0°.67
4ˢ.162	15°	15.43	17°.07	0°.23	4ˢ.54	10°	8.32	7°.10	+1°.52
7ˢ.573	20°	20.82	21°.67	0°.71	9ˢ.39	5°	3.55	3°.02	+1°.37

Digitized by Google

A note has been published in the American Journal of Science for May, 1885, calling attention to Dr. Weber's result concerning the connection between the chemical constitution and residual elasticity of glass. The subject is of especial interest.

MAGNETIC MEASUREMENTS.

In addition to work in the Thermometric Bureau, investigations have been continued with the magnetic instruments given by Mr. Ely. After October the increase of duties in the Bureau interfered with the regularity of the observations.

The following measurements were made at the station near the Observatory Building.

MAGNETIC OBSERVATIONS UPON THE OBSERVATORY GROUNDS.

Date.	Declination.	Horizontal Force.	Dip.
June 16 and 17, 1884,	8° 56′ 19″	1.7836	72° 47′.06
July 11 and 14,	8 58 6.6	1.7862	72 47.63
Aug. 11, 12, 14,	8 59 19.4	1.7907	72 45.99
Sept. 15, 16, 17,	9 0 10.28	1.7781	72 50.05
Oct. 13,	9 5 46.14		
Nov. 12,	9 6 9.2	1.7812	
Jan. 14, 1885,	8 59 41.5	1.7735	
March 28 and 30,	9 1 41.24	1.7753	
April 22,	9 2 42.8	1.788	72 47.64
May 18,	8 56 54.4	1.782	

Numerous observations have been obtained in adjacent positions showing that these values are greatly affected by the neighboring rocks. Their number is not sufficient to give the amount of disturbance.

The following observations made in the localities named are reported:

Locality.	Date.	Declination.	Horizontal Force.	Dip.	Total Force.
Providence, R. I.,	June 20, 1884,	11° 7′ 42″	1.7376	73° 16′.61	6.0638
Double Beach, Conn.,	July 22, 1884,	9 25.8		72 50.38	6.0762
South End, Conn.,	July 22, 1884,	8 46.16			
Lighthouse Pt., Conn.,	June 30, 1884,			72 46.12	6.0673
Centerville, Conn.,	Aug. 2, 1884,	9 6.24	1.7821		
	June 2, 1885,			72 49.91	6.0535

I am glad to acknowledge my indebtedness to Mr. Brown for a considerable part of the calculation necessary to deduce these results.

Digitized by Google

A MEASURE OF THE DIAMETER OF VENUS.

The following observations were obtained by a Grubb filar micrometer, attached to the eight inch equatorial presented to us by Mr. Reed. The micrometer is essentially represented in figure 2, modified as in figures 5, 7, 8, of the article Micrometer in the ninth edition of the Encyclopedia Britannica. The equality of the several runs of the screws was tested under the microscope by Robert Brown, Jr., Secretary of the Observatory. The departures from the mean values are given in the following table: the unit being the ten thousandth of a revolution.

DEPARTURES FROM EQUALITY OF THE DIVISIONS OF THE MICROMETER SCALE.

	Right Hand Screw.					Left Hand Screw.			
	1st Series.	2d Series.	3d Series.	4th Series.	Mean.	1st Series.	2d Series.	3d Series.	Mean.
0- 1	— 6	—10	0	—11	— 6	— 7	— 6	0	— 4
1- 2	—31	— 5	+ 1	—16	—13	— 3	+ 6	—10	— 2
2- 3	— 1	0	+ 1	+14	+ 3	— 3	+ 1	0	0
3- 4	—16	5	+ 6	+ 4	— 3	+27	+21	0	+16
4- 5	+ 9	—35	+11	+14	0	—28	+ 1	+ 5	— 7
5- 6	— 6	+10	— 4	— 1	0	—28	— 9	—10	—12
6- 7	—11	— 5	— 4	— 1	— 5	— 3	— 4	0	— 2
7- 8	—16	—10	+ 6	+ 4	— 4	+22	— 9	+15	+ 9
8- 9	+24	+15	+21	+ 4	+16	+ 2	+ 6	+20	+ 9
9-10	—26	+10	— 4	+ 4	— 4	—33	+11	+10	— 4
10-11	—11	+15	—19	—11	— 6	+ 3	+21	0	+ 8
11-12	— 1	0	— 4	—21	— 6	+ 8	— 9	— 5	— 2
12-13	— 1	—20	—24	—11	—14	— 2	+ 1	+ 5	+ 1
13-14	—11	—10	+ 6	— 1	— 4	—18	— 4	—15	— 9
14-15	— 1	+20	—14	—11	— 1	—18	—14	+ 5	— 8
15-16	—21	— 5	+ 1	+24	0	— 2	— 9	+ 5	— 2
16-17	— 6	+35	— 4	—21	+ 1	—13	+ 6	+10	+ 1
17-18	—16	— 5	+ 1	— 1	— 5	+ 3	+ 1	— 5	0
18-19	+ 4	+25	—11	—11	+ 2	— 2	— 4	+ 5	0
19-20	+24	—10	—19	— 6	— 3	+13	— 9	0	+ 1
20-21	+14	+40	+ 1	+ 9	+16	— 7	—14	+30	+ 3
21-22	+19	— 5	—14	+14	+ 6	+18	—14	— 5	0
22-23	+ 4	+15	+16	+ 9	+11	+13	+ 1	—40	— 6
23-24	+14	— 5	+11	—11	+ 2	+ 3	+ 6	0	+ 3
24-25	+ 9	+20	+ 6	— 1	+ 8	+33	+16	—15	+11
25-26	+14	— 5	+16	—11	+ 5	——	——	0	0
26-27	+14	—30	+ 1	—14	— 7	——	——	+10	+10
27-28	+ 4	+ 5	+11	+34	+13	——	——	——	——
28-29	+29	—15	0	—21	— 2	——	——	——	——
29-30	— 6	—15	+ 1	—19	0	——	——	——	——
30-31	—11	—10		— 6	— 9	——	——	——	——

The observations in the following series falling almost

Digitized by Google

entirely between the fourteenth and nineteenth divisions, these variations have been deemed negligable.

By comparison of the mean linear values of a revolution as derived from each series it is found that

1 revolution of the left hand screw = 1.0064 of the mean of both.
1 " " right hand screw = 0.9936 " " " "

The screws being designated right or left according as they are upon the right or left hand of the observer facing the micrometer so placed that its scale is erect. Throughout these measures the mean of the interval measured upon both screws has been employed.

The value of a revolution has been obtained from star transits. The temperature, the mean value of an interval, and the number of transits of a single interval upon which the value depends are given in the successive columns of the adjoining table.

Temperature in degrees (Cent.)	Mean value of a Revolution.	No. of single Transits.
−10°.10	34.″3631	367
−10.00	34 3797	578
− 8.17	34.3459	300
+ 5.07	34.3178	835
+18.79	34.2724	839
+21.25	34.2819	441
+2°.81	34″.3273	

from which we readily derive the value for the mean of the distance passed over by a single revolution of both screws, as

$$r = 34''.3289 + 0''.00355\,(2°.81 - \tau)$$

at 60°.95 F., the temperature to which the values in the present work are referred, the value becomes 34″.2818.

In observing, the practice was to bring the two webs tangent to either edge of the planet's disc and having read the scales to interchange the webs and again read the scales. The mean of the two intervals thus observed was accepted as the measure. To vary the conditions and the amount of personality, series were conducted with the full number of eye pieces obtainable; viz., powers 135, 160, 210, 320, 360.

The values belonging to each series, corrected for temperature and refraction have then formed part of a series of equations of the form

$$D - r(n+i) = O$$

Digitized by Google

in which D is the planet's diameter, r the planet's geocentric distance, n the corrected scale reading, i the sum of the personal error of the observer, and the semi-thickness of the wires.

On Sept. 17th, the webs were observed to "fiddle." In remedying the evil the web was broken. A similar occurrence in October breaks the series into three. The first, extending from March 4 to September 17, 1884, are the only set strictly suited for discussion.

Of the five series, two, those with powers 135 and 360 present anomalous results. The cause for the discrepancy not being as yet ascertained, the values are not given. The remaining three afford

Power 160	$D = 17''.371 \pm 0''.049$	$i = -2''.298 \pm 0''.058$
Power 210	$D = 17.200 \pm 0.045$	$i = -1.925 \pm 0.056$
Power 320	$D = 17.317 \pm 0.041$	$i = -1.174 \pm 0.049$

At Dr. Elkin's suggestion a number of observations were taken with different apertures. The result is as follows: The diameter with 8 in. aperture is greater than the diameter with 6 in. aperture by $0''.22$. The diameter with the 8 in. aperture is greater than the diameter with 4 in. aperture by $0''.27$.

A great amount of time has been spent with the spectroscope, but, on account of many untoward circumstances, no result can be reported. It is intended to frequently observe the spectrum of a number of stars and to catalogue that of those nebulæ which are within reach.

In March, the Chief Signal Officer placed a rain guage at the Observatory for the sake of comparing its collection with that at the signal service station. The results for the intervening two months are as follows:

	Observatory.	Signal Service.
April,	2.727	2.31
May,	2.928	2.61

Very respectfully,

ORRAY T. SHERMAN,

Astronomer in charge of the Thermometric Bureau.

Digitized by Google

REPORT OF DR. ELKIN.

YALE COLLEGE, June 5, 1885.

To the Board of Managers of the Yale College Observatory:

GENTLEMEN—I beg leave to lay before you my statement of work with the Heliometer during the past year.

The principal object of research has been the triangulation of the Pleiades, to which work the instrument was devoted from September, 1884, to March, 1885. It was originally intended to confine the investigation to the stars measured at Königsberg and to carry out only one method of triangulation. The scheme has been extended, however, to include all the stars in the Bonn Durchmusterung, within certain limits, down to the magnitude 9.2, making 69 stars in all, and also to obtain a determination of the relative positions of the stars which should be strictly comparable with the Königsberg work, viz: measurement of distances and angles of position of the stars from Alcyone. The original plan contemplated only a limited use of measures of angles of position, and the places of the stars were to depend on measures of distance only from four stars which form a large quadrilateral inclosing the major portion of the group, the relative position of these four stars naturally to be ascertained with the greatest possible accuracy. Both these plans have been carried out in a fairly complete manner, at least for the stars of Bessel's list; it may be advisable to secure next season the measures still wanting for those stars not in Bessel's list, which, being all faint, were not possible to get during the past, for the most part, hazy winter. The observations have been all reduced provisionally; the final reduction cannot be undertaken until the results of the meridian observations of the end stars of two zones serving to determine the scale value and zero of position have been received from the observatories which have kindly consented to make them.

Of other observations I have to report:

Measures of the Moon from neighboring stars have been made on 36 nights near the first and last quarters, which should give 88 independent positions of the Moon. It appears advisable, before devoting much more time to this work, to

Digitized by Google

test the value of the method by a complete reduction and discussion of the measures already secured, which should prove sufficient for this purpose. It is therefore not proposed to carry on these observations at present. In connection with this work the places of the three craters which have been chosen as reference points have been determined each on several nights by measures from the Moon's limb, and the diameter of the Moon has been measured at opposition on seven occasions, generally in 36 directions. There has also been made a series on the diameter of Venus, 102 measures on 50 days with different powers and apertures, one on the outer ring of Saturn on 57 nights and a short series (22 obs.) of Titan referred to its primary.

The investigation of the division errors of the scales has been carried as far as the determination of the errors of each five-division line on both scales. The errors are small and regularly progressive, so that a more complete research appears hardly necessary except in special cases. In the central portion of the scales each division has been investigated.

There have been various additions made to the working appliances of the instrument. The motion in position angle has been facilitated by an extra handle and the oil lamp illuminating the scales has been replaced by a ½-candle incandescent lamp. This is of considerable importance, as in certain positions of the instrument the oil lamp hung vertically below the object glass, a state of things fatal to definition and accurate work. The most important addition is, however, the registering micrometer which Messrs. Repsold have made for reading the scales. The principle consists in impressing on a Morse fillet the figures and divisions of the micrometer head along with those of a fixed index. The instrument is of exquisite design and workmanship, and has proved a complete success in the line to which it was intended to be devoted. Besides the advantages of a permanent and indisputable record of the observation and absolute freedom from prejudice, the saving in time brought about by its use is very considerable.

It is now proposed to devote the instrument to systematic investigations in stellar parallax, and a plan of work has been laid out and commenced which, if carried to completion, will furnish, it is hoped, a reliable value of the relative parallax of

Digitized by Google

the stars of the first and eighth magnitudes. As, however, the work is only just started, I beg leave to defer the details of the scheme until my next report.

Respectfully,

W. L. ELKIN,

Astronomer in charge of the Heliometer.

Digitized by Google

Digitized by Google

Yale college - Observatory. Educ R560315.9

Sci 772.5
4

Report for the Year 1885–6, presented by the Board of Managers of the Observatory to the President and Fellows of Yale College.

Digitized by Google

HARVARD COLLEGE
SEP 24 1886
LIBRARY.

By mail

OBSERVATORY IN YALE COLLEGE.

BOARD OF MANAGERS.

Rev. NOAH PORTER, D.D., LL.D., *President.*

THOMAS G. BENNETT, PH.B., of New Haven.

JACOB CAMPBELL, ESQ., of New York.

Professor ELIAS LOOMIS, LL.D.

Professor CHESTER S. LYMAN, M.A.

Professor HUBERT A. NEWTON, LL.D., *Secretary.*

OFFICERS.

ROBERT BROWN, Jr., M.A., *Secretary.*

LEONARD WALDO, S.D., *Astronomer in charge of the Horological Bureau.*

ORRAY T. SHERMAN, B.A., *Astronomer in charge of the Thermometric Bureau.*

WILLIAM L. ELKIN, Ph.D., *Astronomer in charge of the Heliometer.*

Digitized by Google

REPORT.

To the President and Fellows of Yale College:

GENTLEMEN: — We submit herewith the reports of the Secretary and the Astronomers of the Observatory. These reports explain in detail the work done by the several officers during the past year.

Very respectfully,

THE BOARD OF MANAGERS,

of the Observatory in Yale College.

YALE COLLEGE, June 22, 1886.

SECRETARY'S REPORT.

YALE COLLEGE, June 22, 1886.

To the Board of Managers:

GENTLEMEN: — I have the honor to report that during the year ending June 1st, 1886, the property under your control has been improved in the following respects: —

1. Canner street, immediately west of St. Ronan street, has been filled to grade on the south side; the deep fill of the portion occupied by the sidewalk, for about 100 feet in length, having been omitted in the first grading. The curbstone and the cobble-stone gutter and the row of elm trees, with the grass border to the sidewalk, have been continued to St. Ronan street. In making this fill, a considerable part of the sidewalk on the north side has been excavated.

Digitized by Google

2. The concrete sidewalk previously laid on the south side of Canner street has been continued to Prospect street, and thence, on the east side of Prospect street, southwardly, to the southern boundary of your property; from which point the only gap in a continuous walk to the colleges, has been filled, in an obliging spirit, by our neighbors, with a wide flagstone sidewalk. The principal portion of the concrete walk on your land has been laid at the expense of anonymous contributions.

3. The sidewalk has been graded on the east side of Prospect street northwardly from Canner street, for about half the distance to Highland street, toward which its construction is being continued. This grading seems to be a prerequisite to a fence which will not require continuous repair, and which will restrain a considerable portion of the trespasses now committed with comparative impunity. Incidentally to the grading here spoken of, the drives in the Observatory grounds have been improved, and tendencies to washing away removed or reduced, a fair proportion of the expense being charged to repair account.

The merely routine duties of my office, while filling my time, present no items of interest not covered by other reports.

The contributions to the Library of the Observatory during the year ending June 1st, 1886, have been as follows: —

Prof. H. A. Newton.	American Meteorological Journal, vols. 1 and 2, in numbers. 1884–5. 8°.
The Observatory.	Cambridge, Harvard College Observatory, 40th annual report of the Director. 8°. *Cambridge*, 1886.
The Lords Commissioners of the Admiralty.	Cape Town, Catalogue of 12,441 Stars for the Epoch 1880, from observations made at the Cape of Good Hope during the years 1871 to 1879. Edward James Stone. 4°. *London*, 1881.
———	—— Catalogue of 4,810 Stars for 1850, from observations made at the Royal Observatory, Cape of Good Hope, during the years 1849 to 1852 under Sir Thomas Maclear. Reduced by David Gill. 8°. *London.*

Digitized by Google

Cincinnati, Publications of the Observatory. 8°; Mr. Robert Brown.
No. 7. Observations of the Comets of 1880, 1881 and 1882, made under the direction of Osmond Stone, Astron., and Herbert C. Wilson, Astron. *pro tem.*
No. 8. Observations of the Comets of 1883, by H. C. Wilson, A.M., Astron. *pro tem.*
Cincinnati, 1885.

Connecticut, Board of Railroad Commissioners, 33d annual report (1886). 8°. *Hartford*, 1885. The Commissioners.

Córdoba, Resultados del Observatorio Nacional Argentino. B. A. Gould, Director. Vols. iii. and iv. Observaciones del año 1873. 4°. *Buenos Aires*, 1884. Prof. J. D. Dana.

—— Resultados. B. A. Gould, Director. Vols. vii. and viii. Catálogo de las zonas Estelares o^h Á $xxiv^h$. 4°. *Cordoba*, 1884. The Observatory.

Davidson, G. Methods and Results. U. S. Coast and Geodetic Survey. Appendices to the report for 1884. 4°. *Washington*, 1885. The Author.
No. 8. Run of the Micrometer.
No. 10. Heights of the Stations of the Davidson quadrilaterals from trigonometrical determinations.

Dublin, Royal Society, Scientific Transactions. Vol. iii. (Series II.) in part. 4°. The Society.
VII. Notes on the Aspect of the Planet Mars in 1884, accompanied by sketches made at the Observatory, Birr Castle. By Otto Bœddicker, Ph.D.
IX. On the Changes of the Radiation of Heat from the Moon during the Total Eclipse of 1884, October 4, as measured at the Observatory, Birr Castle. By Otto Bœddicker, Ph.D. *Dublin*, 1885.

Dun Echt, Observatory Publications. Vol. iii. Mauritius Expedition, 1874. Division II: Determinations of Latitude and Longitude. 4°. *Aberdeen*, 1885. The Earl of Crawford and Balcarres.

—— Observatory Circulars, Nos. 94–122. ——

Digitized by Google

The Astronomer Royal. Greenwich, Rates of Chronometers on Trial for purchase by the Board of Admiralty. Royal Observatory, Greenwich. *London*, 1885.

—— —— Astronomical and Magnetical Observations made in the year 1883. 4°. *London*, 1885.

—— —— Corrections to Assumed Mean R. A. of Clock Stars and Circumpolar Stars of the Nautical Almanac for 1886, January 1. 4°.

The Publishers. Jewelers' Circular and Horological Review, New York. Numbers to June 1, 1886. 4°.

The Publishers. Jewelers' Journal, Chicago. Numbers to June 1, 1886. 4°.

The Observatory. Kasan, L'Observatoire de l'Université Impériale. Observations des Etoiles de la zone entre 75° et 80° de déclinaison Boréale, sous la direction de Marian Kowalski. Tome i. Roy. 8°. [Meridian Circle Observations, 1869–77.] *Kasan*, 1885.

The Observatory. Mexico, Observatorio Meteorológico-Magnético Central. Estudios de Meteorología Comparada, par Mariano Bárcena y Miguel Pérez. Tomo i. 8°. *Mexico*, 1885.

—— —— Observatorio Meteorológico Central. Boletin del Ministerio de Fomento de la República Mexicana. Folio. [Semi-weekly numbers to April 3, 1886.]

The Lords Commissioners of the Admiralty. Nautical Almanac and Astronomical Ephemeris for the year 1889. 8°. *London*, 1885.

The Author. Newton, H. A. On the effect upon the Earth's Velocity produced by small bodies passing near the Earth. 8°. *New Haven*, [1885].

The Commission. Norwegische Commission der Europäischen Gradmessung Geodätische Arbeiten. 4°. *Christiania.*

Heft I. Die Basis auf Egeberg bei Christiania; und auf Rindenleret bei Levanger. 1882.

Heft II. Die Verbindung der Basis bei Christiania mit der Hauptdreiecks-Seite Toaas-Kolsaas. 1880.

Heft III. Die Verbindung der Basis auf dem Rindenleret mit der Hauptdreiecks-Seite Stokvola-Haarskallen. 1882.

Digitized by Google

Heft IV. Das Nördliche Dreiecknetz zur Verbindung der Haupt-Dreieckseiten Haarskallen-Stokvola und Spaatfind-Nävorfjeld. 1885.

Pickering, E. C. A New Form of Polarimeter. 8°. — The Author.

—— Atmospheric Refraction. 8°. ——

—— Observations of Variable Stars in 1885. 8°. ——

—— Accurate Mountain Heights. 8°. ——

Prague, K. K. Sternwarte. Magnetische und Meteorologische Beobachtungen in Jahre 1884. 45 Jahrgang. Prof. D. L. Weinek, Director. 4°. *Prag*, 1885. — The Observatory.

Pulcowa (Nicolai Hauptsternwarte). — The Observatory.

Jahresbericht am 27 Mai, 1884. 8°. *St. Petersburg*, 1884.

Jahresbericht am 25 Mai, 1885. 8°. *St. Petersburg*, 1885.

Tabulæ Quantitatum Besselianarum pro annis 1885–1889. 8°. Otto Struve. *St. Petersburg*, 1885.

Sammlung der Beobachtungen von Sternbedeckungen während der Totalen Mondfinsterniss 1884, Oct. 4. Otto Struve.

Oxford, Radcliffe Observatory, Results of Astronomical and Meteorological Observations made in 1882. Vol. xl. 8°. *Oxford*, 1885. — The Observatory.

Rousdon Observatory, Devon, Astronomical Observations, 1882–5, made under the superintendence of Cuthbert E. Peek, M.A. 4°. *London*, 1886. — The Observatory.

St. Petersburg, Académie Impériale des Sciences, Mémoires. VII^me^ Série, Tome xxxii. 4°. *St. Petersburg*, 1884. — The Academy.

No. 3. O. Backlund. Untersuchungen über die Bewegung des Encke'schen Cometen 1871–81.

No. 4. O. Backlund. Zur Entwickelung der Störungsfunction.

No. 6. Ed. Lindemann. Helligkeitsmessungen Bessel'schen Plejadensterne.

Digitized by Google

No. 11. H. Gyldén. Theoretische Untersuchungen über die intermediären Bahnen der Cometen in der Nähe eines Störenden Körpers.

No. 15. Dr. B. Hasselberg. Zur Spectroskopie des Stickstoffs. I, Untersuchungen über das Bandenspectrum.

The Author. Smyth, C. Piazzi. Micrometrical Measures of Gaseous Spectra under High Dispersion. 4°. *Edinburg*, 1886.

The Observatory. Tacubaya, Observatorio Astronómico Nacional. Annuario para el año de 1886. Ángel Anguiano. Año VI. 12°. *Mexico*, 1885.

The Author. Tischner, A. The Fixed Idea of Astronomical Theory. August Tischner. 8°. *Leipsig*, 1885.

The Institute. Toronto, Canadian Institute. [Vol. iii., fasciculi 2 and 3.] Proceedings. July, 1885, and Feb., 1886.

The Observatory. University of Virginia, Leander McCormick Observatory. Circulars Nos. 1 and 2.

The Academy. Vienna, Kaiserlichen Akademie der Wissenschaften. Circulars to Nr. LX.

The Coast and Geodetic Survey. U. S. Coast and Geodetic Survey. Methods and Results. Longitudes determined by Electric Telegraph between 1846 and 1885. Appendix No. 11. Report for 1884. 4°. *Washington*, 1885.

The Society. Washington, Philosophical Society, Bulletin. Vol. viii. 8°. *Washington*, 1885.

Office of the American Ephemeris. United States, Report of Observations of the Total Eclipse of the Sun, Aug. 7, 1869, made by parties under the general direction of Prof. J. H. C. Coffin. 4°. *Washington*, 1885.

Very respectfully,

ROBERT BROWN,

Secretary of the Observatory.

Digitized by Google

REPORT OF DR. WALDO.

[SIXTH ANNUAL REPORT OF THE HOROLOGICAL BUREAU.]

YALE COLLEGE, June 20, 1886.

To the Board of Managers:

GENTLEMEN:—The present report refers to the work of the Horological Bureau for the year ending May 31, 1886.

The methods adopted for the rating of timepieces will be found described in preceding reports. The number of timepieces received from the makers for rating, as compared with preceding years is as follows:

1880–81	219	1882–83	41	1884–85	58
1881–82	53	1883–84	87	1885–86	74

The experiments in the construction of precision clocks have been continued. There being no very convenient facilities for this work at the observatory building, I have, with your permission, erected a private laboratory at my own expense, with a well built clock room, in the rear of the residence at 459 Prospect street. This laboratory is in working order and a series of experiments has been completed upon two precision clocks mounted therein, with every consideration for stability of support, and the control of their temperature and atmospheric conditions. The apparatus for temperature regulation is found to be efficient, and the work now in progress is expected to throw some new light on the law of compensation for clocks with detached escapements and mercurial-steel pendulums.

The time signals have been transmitted with greater uniformity than in any previous year, to the watchmakers and railroads.

Observations were made on the following number of nights each month during the year:

June,	8	October,	12	February,	4
July,	8	November,	5	March,	5
August,	5	December,	10	April,	9
September,	15	January,	4	May,	12

Digitized by Google

The threatened deficit in the finances of the Bureau, mentioned in my last report, was made up by a subscription from the following Railroads and Watch and Clock manufacturing companies toward the expense of maintaining the time signals and timepiece ratings for their benefit:

The New York, New Haven & Hartford R. R. Company.
The Housatonic R. R. Company.
The Naugatuck R. R. Company.
The Hartford & Connecticut Valley R. R. Company.
The American Waltham Watch Company.
The Elgin National Watch Company.
The Seth Thomas Clock Company.
The New Haven Clock Company.
The Springfield (Ill.) Watch Company.
The Hampden (Springfield, Mass.) Watch Company.
The Rockford Watch Company.

The prompt response which these corporations made to the request for their support, is a gratifying evidence of the value of the public services which the Bureau has maintained.

The State Legislature, at their last session, practically refused to reconsider their action in repealing their appropriation to the Observatory for the State Time Service, and the support of that service, if it is to be maintained, must now devolve upon the railroads. The views of the Bureau upon the justice of such support have already been given at length in a letter to the Railroad Commissioners of the State, which is published as an appendix to their report for the year 1886.

The personnel of the Bureau has included, during parts of the year, Mr. Frederic R. Honey, of the Scientific School, and Mr. Edward G. Fullerton, late of the Signal Service, U. S. A. These gentlemen have rendered efficient service in the work of the year.

Respectfully submitted,

LEONARD WALDO,

Astronomer in charge of the Horological Bureau.

Digitized by Google

REPORT OF MR. SHERMAN.

YALE COLLEGE OBSERVATORY, June 20, 1886.

To the Board of Managers of the Observatory in Yale College:

GENTLEMEN:—During the period from June 1, 1885, to June 1, 1886, the Thermometric Bureau has been called upon to examine six thousand three hundred and fifty-five (6,355) instruments.*

These have included a range of comparison from −40° C. to +300° C. Some have also been subjected to the treatment defined in last year's report, to render their indications stable at high tempatures.

It is with great satisfaction that the Bureau notes a decided improvement, since the first year of its operation, in the clinical thermometers of the better grades sent us by American makers.

Apart from the routine work studies have been conducted intending to display and eliminate the errors which adhere to a thermometer reading on account of the individual peculiarities of the observation or instrument other than those produced by the composition of the glass, also other studies relating to the thermometric standards; but in this as in the magnetic work, many unavoidable interruptions, and the pressure of the routine work, have combined to render no result ready for announcement.

The comparisons of rainfall at the Observatory and at the local Signal Service Station, undertaken at the request of the Chief Signal Officer, have been continued throughout the year. The results are as follows:

*The numbers for the several years of operation of the Bureau are:—

1880—1881....1946	1883—1884....6392
1881—1882....4533	1884—1885....5717
1882—1883....5324	1885—1886....6355

Digitized by Google

MONTHLY RAINFALL IN INCHES.

Month.	Observatory.	Signal Service.	Ratio.
June 1, 1885,	1.59 inches.	1.43 inches.	1.11 inches.
July,	2.89	2.51	1.15
August,	8.38	8.13	1.03
September,	0.96	0.77	1.25
October,	6.72	5.37	1.25
November,	4.74	3.49	1.36
December,	4.11	3.31	1.24
January, 1886,	---	3.53	---
February,	---	5.95	---
March,	4.37	3.19	1.37
April, 1883,	2.73	2.31	1.18
April, 1886,	5.20	3.21	1.62
May, 1885,	2.93	2.61	1.12
May, 1886,	3.66	2.73	1.34

Or; the Observatory has received twenty-four per cent. more rain than the Signal Service Station. The distance between the two is about a mile and a quarter. The Observatory gauge is on the ground, the Signal Service's gauge is on the very high roof of the Insurance Building.

The Equatorial has throughout the year been applied to spectroscopic work. Its outfit has, by your permission, been increased by the usual means of producing comparison spectra, by a Rowland flat grating, 14,347 lines to the inch, and by the means of attaching the same.

Announcements have been made as follows:—

(1.) The Spectrum of Nova Andromedæ, (Am. Jour. Sci., vol. xxx, Nov., 1885, p. 379.) Two bright lines were detected agreeing with two lines in the spectrum of the solar chromosphere, 1474 and 1250. This result agreed with that announced by Mr. Maunder of Greenwich, but was not obtained by any other spectroscopist.

(2.) Bright Lines in Stellar Spectra, (Am. Jour. Sci., vol. xxx, Dec., 1885, p. 475.) A large addition was made to the number of bright lines seen in the spectrum of γ Cassiopeiæ and the existence of similar appearances in the spectra of other stars asserted. The announcement has met with criticism. In a note addressed to the Royal Astronomical Society of London, and submitted herewith, I have endeavored to

Digitized by Google

answer the questions raised before that Society and to show more fully the method of observation and the appearances observed.

(3.) Note on the Spectrum of Comet C. 1886, (Am. Jour. Sci., not yet published.) The comet presented to telescopic view a faint oval of light. By using no slit, carefully excluding all foreign light and protecting the eye, there were detected more than the usual number of bands, so placed as to bear considerable resemblance to a low temperature spectrum of hydrocarbon.

A study was also made upon the spectrum of Nova Orionis, but on account of difficulties in the way of the interpretation it has not been published. Observations of the spectra of sun spots and protuberances have also been taken, as occasion offered.

It is expected to continue to employ the instrument in following the spectra of certain stars, and in gathering observations of sun spots and protuberance spectra.

Very respectfully,

ORRAY T. SHERMAN,

Astronomer in charge of the Thermometric Bureau.

Digitized by Google

REPORT OF DR. ELKIN.

YALE COLLEGE, June 14, 1886.

To the Board of Managers of the Yale College Observatory:

GENTLEMEN: — During the past year the work with the Heliometer has progressed as follows:

Some further observations of the Pleiades have been secured which complete the series obtained in the previous year; all the stars have now been observed on from ten to twelve nights, and a total of over 1600 measures of distance and 700 of position-angle are available for discussion. The essential and heavy parts of the reductions are completed, and there remain only one or two points of detail to be disposed of before the definitive results may be arranged for publication.

The principal observing work on my part, however, has been in connection with a scheme for determining the average parallax of the first magnitude stars as a first step towards the more comprehensive plan outlined by Dr. Gill and myself. What is proposed at present is to take the ten brightest stars in the Northern Hemisphere and observe them each from 16 to 20 times at epochs of maximum paralactic displacement, using a favorably situated pair of comparison stars, in some cases a double pair or four stars. It will be understood that it is not expected that each individual resulting parallax will be of very great accuracy from so limited a series, but that the mean of the ten parallaxes will give, it is hoped, a fairly reliable value for the average distance of the most brilliant stars. Arcturus, however, with its large proper motion, presents an object of especial interest, and it has been taken up in a more exhaustive manner with six pairs of comparison stars, five of which have been successfully followed up so far. The whole work is progressing satisfactorily, over 200 sets of measures having been made, and is rather more that half completed, the working plan extending until February, 1887.

Since September, 1885, Mr. Asaph Hall, Jr., has been engaged in observing with the Heliometer, the object in view being a determination of the mass of Saturn from measures of

Digitized by Google

Titan. He has secured 49 complete sets (16 pointings) and 19 half sets (8 pointings) of such measures. He has also observed various stars for an independent determination of the instrumental constants, and has investigated the division errors of part of the scale used in the observations of Titan.

No changes of consequence have been made with the instrument; incandescent lamps are now used for reading the circles of position and declination, the battery power being derived from three or four bichromate cells, which are easy to be cared for, and seem for our purpose to offer the simplest solution of the problem.

Respectfully,

W. L. ELKIN,

Astronomer in charge of the Heliometer.

ERRATA.

Page 5, line 4, for *Osmond*, read *Ormond*.
" 5, " 16, " *zonas*, read *Zonas*.
" 6, " 15, " *Boréale*, read *boréale*.
" 6, " 33, after *Gradmessung*, insert period.
" 7, " 11, for *in*, read *im*.
" 7, " 15, omit *am 27 Mai, 1884*.
" 7, " 17, " *am 25 Mai, 1885*.
" 7, last line, insert *der*, before *Bessel'schen*.
" 8, line 21, for *Kaiserlichen*, read *Kaiserliche*.
" 11, " 11, " *tempatures*, read *temperatures*.
" 12, " 3, omit *inches*, after last column.
" 12, " 13, for *1883*, read *1885*.
" 14, " 20, " *paralactic*, read *parallactic*.
" 14, " 32, " *that*, read *than*.
" 15, " 5, before *part*, insert *the*.

Digitized by Google

Digitized by Google

Edue B 5603.35

Sci 772.5
4

Report for the Year 1886–7, presented by the Board of Managers of the Observatory of Yale University to the President and Fellows.

Digitized by Google

Digitized by Google

OBSERVATORY OF YALE UNIVERSITY.

BOARD OF MANAGERS.

Rev. TIMOTHY DWIGHT, D.D., LL.D., *President.*

JACOB CAMPBELL, ESQ., of New York.

Professor ELIAS LOOMIS, LL.D.

Professor CHESTER S. LYMAN, M.A.

Professor HUBERT A. NEWTON, LL.D., *Secretary.*

THOMAS G. BENNETT, PH.B., of New Haven.

Professor CHARLES S. HASTINGS, PH.D.

OFFICERS.

ROBERT BROWN, M.A., *Secretary.*

WILLIAM L. ELKIN, Ph.D., *Astronomer in charge of the Heliometer.*

ASAPH HALL, Jr., *Assistant Astronomer.*

Digitized by Google

Digitized by Google

REPORT.

YALE UNIVERSITY, June 25, 1887.

To the President and Fellows:

GENTLEMEN:—We herewith transmit to you the Report for the past year of the Secretary of the Observatory, and that of the Astronomer in charge of the Heliometer.

The three years period for which the subscriptions had been made for the support of the work with the Heliometer expired with the last calendar year. A renewal of the subscription has been generously granted for another period by the following ten persons, each paying one hundred dollars a year:—

AN ANONYMOUS FRIEND.	
ELIAS LOOMIS,	Class of 1830.
MRS. K. FELLOWES WHEELER. (Continuing her father's subscription.)	
CYPRIAN S. BRAINERD,	Class of 1850.
HUBERT A. NEWTON,	" "
ROBERT BROWN,	" 1857.
HENRY F. DIMOCK,	" 1863.
LEVI C. WADE,	" 1866.
GEORGE T. BLISS,	" 1873.
EDWARD W. SOUTHWORTH,	" 1875.

The Trustees of the Bache Fund of the National Academy of Sciences granted us a second appropriation of $600 to enable Mr. Hall to make more complete his measurement of the mass of Saturn. The work of the first year would probably have given a good determination of the planet's mass, but in view of the importance of this constant in Physical Astronomy it seemed desirable to continue the observations through another year so as to obtain the best possible result.

The expense of printing and distributing Dr. Elkin's Memoir upon the Pleiades, amounting to $650, has been borne by Professor Loomis.

Digitized by Google

The establishment of the Horological Bureau in 1879, was made with the express understanding, that the Bureau should be self-supporting and should under no circumstances become a pecuniary burden to the Observatory. The experience of eight years has clearly shown that as yet there is not enough demand for the testing of time-pieces in this country to justify the immediate continuance of this work. The largest number of watches presented in any one year to be tested has been 219, and during the past year this number has been reduced nearly if not quite to zero. The Astronomer who has had charge of the Bureau from its first organization has resigned his connection with the University. The watch and clock companies have in past years generously contributed towards the support of the Bureau, and the Observatory should hold itself in readiness to respond to any indications on their part that the resumption of its peculiar work, the testing of time-pieces, is desired and will be useful to them.

The Observatory time-service has been of very great advantage to the public, and should be continued so long as its expense can be provided for without burden to the University. Since the benefit accrues to the public throughout the whole State it is very proper that the State should itself bear the expense of it. This service will be carried on by Mr. Hall, the Assistant Astronomer.

The Thermometric Bureau was under the charge of Mr. Sherman until his resignation in November last. We regret the loss of Mr. Sherman's services, but the work of the Bureau is being well and faithfully done. Previous to his departure Mr. Sherman had been engaged in spectroscopic studies with the Reed Equatorial. Some interesting results of his work have been published by him in the scientific journals.

Respectfully submitted by

THE BOARD OF MANAGERS.

Digitized by Google

SECRETARY'S REPORT.

YALE OBSERVATORY, June 21, 1887.

To the Board of Managers:

GENTLEMEN:—I have the honor to report that during the year ending June 1st, 1887, the only notable improvement of the Observatory property permitted by our limited resources, has been the continuation of the grading of the sidewalk on the east side of Prospect street, from Highland street southwards, to meet the work of the preceding year. A part of this —from about 350 to 650 feet south of Highland street—being through hard rock, remains unfinished, although most of the rock has been removed. Except for this distance, of about 300 feet, the sidewalk has been graded and put in grass, and elm trees planted.

The contributions to the Library of the Observatory during the year ending June 1st, 1887, have been as follows:—

American Meteorological Journal, vol. 3, in numbers. 1886–7. 8°. *Ann Arbor*, 1886–7.	Prof. H. A. Newton.
American Ephemeris and Nautical Almanac for the year 1889. 1886. 8°. (2 copies). *Washington*, 1886.	Office of the American Ephemeris.
Armagh. Second Catalogue of 3300 stars, for the Epoch 1875, from Observations made at the Armagh Observatory during the years 1859 to 1883. J. L. E. Dreyer. 8°. *Dublin*, 1886.	The Observatory.
Bredichin, Th. Quelques remarques concernant mes recherches sur les comètes. 8°. *Moscow*, 1884.	The Author.
—— sur les anomalies apparentes dans la structure de la grand comète de 1744. 8°. *Moscow*, 1884.	——
Cambridge. Harvard College Observatory, 41st Annual Report of the Director. 8°. *Cambridge*, 1887.	The Observatory.

Digitized by Google

——— —— Annals of the Astronomical Observatory of Harvard College, vol. XVI. Observations of fundamental stars made with the meridian circle during the years 1870 to 1886. Prepared for publication under the direction of Joseph Winlock and Edward C. Pickering, by Wm. A. Rogers. 4°. *Cambridge*, 1886.

——— —— Henry Draper Memorial; First Annual Report of the Photographic study of stellar spectra conducted at the Harvard College Observatory. Edward C. Pickering, Director. 4°. *Cambridge*, 1887.

The Observatory. Cape of Good Hope. Annals of the Royal Observatory. Vol. II, Part I. Observations of the Great Comet 1882, II. 4°.

——— —— Results of meridian observations made at the Royal Observatory, during the years 1879, 1880 and 1881, under the direction of David Gill. 8°.

J. D. Dana. Córdoba. Resultados del Observatorio Nacional Argentino. Juan M. Thome, Director. Vol. v. Observaciones del año 1874. 4°. *Buenos Aires*, 1886.

J. D. and E. S. Dana. —— Resultados del Observatorio Nacional Argentino. B. A. Gould, Director. Catálogo General Argentino. Vol. xiv. 4°. *Córdoba*, 1886.

The Author. Davis, Wm. M. Thunder storms in New England in the summer of 1885. Report made for the New England Meteorological Society. 8°. *Cambridge*, 1886.

The Author. D'Engelhardt, B. Observations Astronomiques. Part I. 4°. *Dresden*, 1886.

The Author. Döllen, W. Stern-Ephemeriden auf das Jahr 1887, zur Bestimmung von Zeit und Azimut mittelst des tragbaren Durchgangsinstruments im Verticale des Polarsterns. 8°. *St. Petersburg*, 1886.

——— —— Zeitstern-Ephemeriden auf das Jahr 1886 für die Zeitbestimmung vermittelst des tragbaren Durchgangsinstruments im Verticale des Polarsterns. 8°. *St. Petersburg*, 1886.

Digitized by Google

Edinburgh. Astronomical Observations made at the Royal Observatory. Being vol. xv. for 1878 to 1886. Containing the remainder of the Star Catalogue, Discussion, and Ephemeris for 1830 to 1890. C. Piazzi Smyth. 4°. *Edinburgh*, 1886. — The Observatory.

Geneva. Rapport sur le Concours pour le réglage des Chronomètres pendant l'année 1885. Présenté à la Société des Arts, le 15 Mars 1886, par M. Em. Gautier. 8°. (2 copies). — The Observatory.

Greenwich. Astronomical, Magnetical and Meteorological Observations made at the Royal Observatory in the year 1884, under the direction of W. H. M. Christie. 4°. *London*, 1886. — The Observatory.

Havana. Observaciones Magnéticas y Meteorológicas del Real Colegio de Belen de la Compañia de Jesus. 4°. [3 Nos., Jan. to Sept., 1885.] *Havana*, 1885. — The College.

Haverford College Observatory, Longitude of, by Isaac Sharpless. [Amer. Phil. Soc., April 6, 1883.] 8°. — The Observatory.

Jewelers' Circular and Horological Review. Numbers to June, 1887. 4°. *New York*, 1886–87. — The Publishers.

Jewelers' Journal. Numbers to July, 1886. 4°. *Chicago*, 1886. — The Publishers.

Kalocsa. Berichte von dem erzbischöflich Haynaldschen Observatorium über die daselbst in den ersten fünf Jahren ausgeführten Arbeiten. Carl Braun. 4°. *Münster i. W.*, 1886. — The Observatory.

Karlsruhe. Veröffentlichungen der grossherzoglichen Sternwarte. Zweites Heft. W. Valentiner. 4°. *Karlsruhe*, 1886. — The Observatory.

Koerber, Felix. Über den Cometen 1865, I. 8°. *Breslau*, 1887. — The Author.

Leipzig. Publicationen der K. Universitäts-Sternwarte. Heft. I. 4°. Carl Bruhns and H. Bruns. *Leipzig*, 1882. — The Observatory.

Digitized by Google

The Observatory. Mexico. Observatorio Meteorológico Central. Boletin del Ministerio de Fomento de la República Mexicana. Tomo x. Folio. [Semi-weekly numbers to May 26, 1886].

The Observatory. Moscow. Annales de l'Observatoire. Vol. x. 2 livraison. Th. Bredichin. 4°. *Moscow*, 1884.

The Lords Commissioners of the Admiralty. Nautical Almanac and Astronomical Ephemeris for the year 1890. 8°. *London*, 1886.

The Author. Newton, H. A. The Meteorites, The Meteors and The Shooting Stars. An Address before the Amer. Assoc. for the Adv. of Science, at Buffalo, Aug., 1886. 8°. *Salem*, 1886.

The Observatory. Oxford, Radcliffe Observatory. Results of Astronomical and Meteorological Observations made in 1883, under the supervision of Edward James Stone. Vol. xii. 8°. *Oxford*, 1886.

The Author. Pickering, Edward C. A Plan for the Extension of Astronomical Research. 8°. *Cambridge*, 1886.

——— —— An Investigation in Stellar Photography, conducted at Harvard College Observatory. 4°. [Mem. Amer. Acad. Vol. xi.] *Cambridge*, 1886.

——— —— Comparison of Maps of the Ultra Violet Spectrum. 8°. [Amer. Jour. Sci., vol. xxxii, Sept., 1886].

The Observatory. Prague. K. K. Sternwarte. Astronomische Beobachtungen im Jahre 1884. Enthaltend Originalzeichnungen des Mondes. L. Weinek, Director. 4°. *Prague*, 1886.

——— —— —— Magnetische und Meteorologische Beobachtungen im Jahre 1885. L. Weinek, Director. 4°. *Prague*, 1886.

The Observatory. Pulcowa. (Nicolai-Hauptsternwarte). Jahresbericht. 8°. *St. Petersburg*, 1886.

The Observatory. Rochester. Warner Observatory. History and work, 1883–1886. Vol. I. 8°. (2 copies). *Rochester*, 1887.

Digitized by Google

Santiago. Observaciones Meteorológicas hechas en el Observatorio Astronómico. José Ignacio Vergara, Director. 1882–84. *Santiago*, 1885. — The Observatory.

St. Petersburg, Académie Impériale des Sciences, Mémoires. VII^me^ Série, Tome xxxiv. 4°. *St. Petersburg*, 1886. — The Academy.

No. 2. Magnus Nyrén. Untersuchung der Repsoldschen Theilung des Pulkowaer Verticalkreises nebst Auseinandersetzung der angewandten Untersuchungsmethode.

No. 3. Alexandre Shdanow. Recherches sur l'orbite intermédiaire de la Comète de Faye dans la proximité de Jupiter en 1841.

No. 5. Hermann Struve. Über die Allgemeine Beugungsfigur in Fernröhren.

Socoloff, A. Sur la queue du I Type de la Comète de 1858, V. 8°. *Moscow*, 1884. — The Author.

Tacubaya. Observatorio Astronómico Nacional. Anuario para el año de 1887. Angel Anguiano. Año vii. 12°. *Mexico*, 1886. — The Observatory.

Toronto. Canadian Institute [vol. iii, fasciculus 4, vol. iv, fasciculi 1 and 2]. Proceedings, June and Nov., 1886, and March, 1887. 8°. *Toronto*, 1886–1887. — The Institute.

U. S. Coast and Geodetic Survey. Methods and Results. Magnetic dip and intensity, with their secular variations and Geographical Distribution in the United States. Appendix No. 6. Report 1885. 4°. *Washington*, 1886. — The Coast and Geodetic Survey.

University of Virginia, Leander McCormick Observatory. Vol. i, Part II. Tail of Comet 1882, II. 8°. 1886.

Vol. i, Part III. Nebula of Orion. 8°. 1886. — The Observatory.

Washington. National Academy of Sciences. Report for the year 1885. 8°. *Washington*, 1886. — The Academy.

—— Philosophical Society, Bulletin. Vol. ix. 8°. *Washington*, 1887. — The Society.

Digitized by Google

THE THERMOMETRIC BUREAU.

This department of the Observatory has cause to regret the departure, in November last, of Mr. Orray T. Sherman, under whose conscientious attention and supervision the Bureau has attained its present measure of usefulness. The number of instruments compared during the year ending June 1st, 1887, was 6,224, or about the same as during the previous year.

The improvement noted in last year's report,—both actual, and relative to foreign manufactures,—in the quality of instruments of American manufacture sent here for verification, appears to be fully maintained:—and the Observatory may rightly claim a large share of the credit of this improvement. Machinery for the more exact division of the scales seems to be the principal requisite—and that on the part of a few makers only,—to place them on a perfect equality with the best foreign manufacturers. It may now be fairly said—as it could not have been said before the institution of this Bureau—that the best clinical thermometers of American manufacture compare favorably with the best foreign manufactures, both in the smallness of the amount of the required corrections, and in their uniformity throughout the scale. Without greatly increased compensation to the manufacturer, it cannot be expected that more than a very small percentage of the clinicals of even the best makers, shall indicate the true temperature, at all points of the scale, within $0^{\circ}.1$, whereas thermometers with corrections, reliably ascertained, "large or systematically changing from one end of the scale to the other are not necessarily inferior for the most exact determinations." The very low prices to which competition has forced the lower grades are, of course, inconsistent with extreme accuracy, and account for the most of what is lacking when American manufactures, as a whole, are compared with the better grades of foreign, instruments which, almost alone, reach us. Too large a proportion of the clinical thermometers (foreign or American) sent to us for verification continue to come to us so soon after their manufacture that the corrections given are liable to change with a year's use. Physicians would obtain much more exact indications of temperature, if, estimating the probable annual breakage, they would provide

Digitized by Google

themselves with two or three years' supply of well made, well graduated clinicals and obtain tables of corrections only after the instruments were *known* to have attained a proper age of, say, one or two years. The comparatively small demand for clinicals whose *age* as well as correction is certified, seems to imply that the Medical Profession is not yet generally awake to the exactitude that is practicable in ascertaining body temperature.

ROBERT BROWN,
Secretary of the Observatory.

Digitized by Google

REPORT OF DR. ELKIN.

YALE UNIVERSITY, June 20, 1887.

To the Board of Managers of the Observatory:

GENTLEMEN:—The work in connection with the Heliometer since my last report has progressed as follows:

The reductions of the measurement of the Pleiades made in 1884 and 1885 have been completed, the work passed through the press, and has been distributed as Part I of Vol. I of the Transactions of the Observatory. The general plan and scope of the work have been mentioned in my previous reports, but it may not be out of place to recall them briefly and summarize the results. The measurements furnish the places of 68 stars of the Pleiades relative to Alcyone, or all within a radius of about a degree of this central star down to the magnitude 9.2 of the Bonn charts. The final places result from the combination of the determinations by two independent methods, the comparison of which shows that for the stars brighter than ninth magnitude, at least, the systematic errors of both triangulations are comparatively small. A chief point of interest lies in the confrontation of the Yale work with the best results derivable from Bessel's triangulation of the group with the Königsberg Heliometer, made in 1830–1840, sufficiently long ago, probably, to show the character of the relative motions in the cluster. These prove to be, in general, very small,—so small that, except for about a dozen of the stars compared, another half century will probably have to elapse before any reliable conclusion as to the precise amount and direction of the displacements may be found. Of those stars, however, where this is the case, there are six which have a common drift falling not very far from that which they should show if they did not belong to the cluster, but if this latter were passing over them. In other words, the apparent displacements of these six stars are such that when the absolute motion of the group as a whole—which amounts to some 7″ since Bradley—is taken into consideration, their absolute motions are quite small. In this connection it is perhaps of

Digitized by Google

interest to note that this number, six, is about what we might expect to find as not belonging to the group, since on the area and down to the magnitude under consideration there should be in general some seven or eight stars. In another way the comparison with the Königsberg work is of interest, inasmuch as it furnishes evidence as to which one of two discrepant values for the screw-value of the Königsberg Heliometer is likely to be nearer the truth, a point of considerable importance in view of the numerous results which depend upon this element. Finally, there is some little interest attaching to a comparison of the Yale results with those obtained lately at Paris and Oxford as it discloses, I think I may venture to say, the weakness in part of the filar micrometer for such work and shows the Heliometer triangulation to have not been entirely superfluous.

The observational work during the present year has been principally the continuation of the measures for the determination of the mean parallax of the first magnitude stars. The work is nearly completed, about 350 sets in all having been obtained and the only deficient series are those on Arcturus and Aldebaran, the wanting observations of which will be secured it is hoped this summer and autumn. The latter star has been followed up with three pairs of comparison stars, on account of the large discrepancy between the results obtained at Pulkowa and that found by Prof. Hall at Washington—and I may state that given by one pair with the Heliometer here. The reductions are under way.

The series of measures of Titan for the determination of the mass of Saturn and the satellite's orbit has been continued by Mr. Hall, who has secured 27 complete and 14 half sets, making in all with the measures of last year observations on more than 100 nights. Mr. Hall has made considerable progress in the reductions.

We have also made further measures of the arc in Cygnus and some on that in Eridanus and a series on the Sun's diameter at the request of Prof. Auwers.

Respectfully,

W. L. ELKIN,

Astronomer in charge of the Heliometer.

Digitized by Google

Digitized by Google

Educ R 5603.8.5

Sci 772.5

REPORT FOR THE YEAR 1887–8, PRESENTED BY THE BOARD OF MANAGERS OF THE OBSERVATORY OF YALE UNIVERSITY TO THE PRESIDENT AND FELLOWS.

Digitized by Google

HARVARD COLLEGE
AUG 3 1888
LIBRARY

OBSERVATORY OF YALE UNIVERSITY.

BOARD OF MANAGERS.

Rev. TIMOTHY DWIGHT, D.D., LL.D., *President.*
JACOB CAMPBELL, ESQ., of New York.
Professor ELIAS LOOMIS, LL.D.
Professor CHESTER S. LYMAN, M.A.
Professor HUBERT A. NEWTON, LL.D., *Secretary.*
THOMAS G. BENNETT, PH.B., of New Haven.
Professor CHARLES S. HASTINGS, PH.D.

OFFICERS.

ROBERT BROWN, M.A., *Secretary.*
WILLIAM L. ELKIN, Ph.D., *Astronomer in charge of the Heliometer.*
ASAPH HALL, Jr., *Assistant Astronomer.*

Digitized by Google

REPORT.

YALE UNIVERSITY, June 25, 1888.

To the President and Fellows of Yale University:

GENTLEMEN:—We herewith present to you the Report of the Secretary of the Observatory, and that of the Astronomer in charge of the Heliometer.

The time service has been maintained throughout the year by Mr. Hall the Assistant Astronomer.

A telegraph line has been constructed through Division street to the Railroad, so that the Observatory clock is now directly connected with the telegraph system of the railroads.

Mr. E. M. Reed has manifested his continued interest in our work by purchasing from Messrs. Negus a new and first-class 56 hour Chronometer (No. 1734), and presenting it to the Observatory. This is a valuable and much needed addition to our instrumental equipment.

Respectfully submitted by

THE BOARD OF MANAGERS.

Digitized by Google

SECRETARY'S REPORT.

YALE OBSERVATORY, June 14, 1888.

To the Board of Managers:

GENTLEMEN:—I have the honor to report that during the year ending June 1, 1888, in closely following the spirit of your instructions, I have endeavored to make the labor of our single workman contribute as much as possible to the improvement of the appearance and market value of the property north of Canner street, in the hope that at an early day we may feel the benefit of the extension which has recently been taking place in the northern part of the city to the east of us. The improvements accomplished are:—

1. The completion of the line of shade trees—elms—on the east side of Prospect street, where pits about eight feet square and three feet deep were excavated in the rock and filled in with good loam. The seams in the rock are such that it is judged that when the trees shall have had the good start offered them, they will be able to send their roots far enough for their continued healthy support.

2. On the south side of Highland street, from the corner of Prospect street, eastward, twelve elms have been planted in the sidewalk, the line being interrupted, for the present, at points where excavation in rock would be necessary. The sickness of our laborer shortened the effective period for this work. For the rest of this line, the elms, which have now become scarce in our neighborhood, stand within our grounds, convenient to their destination, having been carefully pruned and root-pruned during the past two years, with this end in view.

3. On the north side of Canner street, from the proposed extension of Hillhouse avenue to St. Ronan street, elm trees have been planted in the sidewalk. Preliminary to this the bank, ranging from two to eight feet high, and about 300 feet long, in the western section was cut down to a grade of two feet above the curb line, at the highest part and tapering to the ordinary grade at each end. About 100 feet, in length, of this

Digitized by Google

bank remains to be removed for about half the breadth of the sidewalk, enough having been removed to make room for the grass edging, six-feet wide, to the sidewalk. Of these 13 elms, 6 required pits, like those on Prospect street, to be excavated in the rock, and filled with good loam. Incidental to this work the springs of water discharging into the gutter have been availed of, as heretofore, as a means of transporting the surplus earth in this bank to the depression on the northwest corner of St. Ronan street, below. In this manner, at no other cost than the labor of throwing the earth down upon the street, in ridges parallel to the gutter, in which the running water was confined, the larger portion of this bank has been removed. By simply planting willow cuttings thickly in the low bottom, which catch and retain leaves and twigs, so much of this washed earth has been deposited by the spent waters that a low dam beyond has sufficed to retain the rest, and the water has passed off comparatively clear into the drains.

4. A few additional trees have been set out on the northeast portion of the Observatory grounds.

The construction by the city of the sewer in Canner street, from Whitney avenue westward to the line of the proposed extension of Hillhouse avenue, has involved a large expense but it is an improvement of corresponding value to the property.

About the middle of January the Observatory received from Director O. Struve, of the Observatory of Pulkowa, a list, especially calculated for this Observatory, of 90 stars whose occultations during and immediately before and after the total eclipse of the Moon, to take place January 28, 1888, it was hoped we would be able to observe. Only a small number of the list could be observed with our eight-inch equatorial, and for this work preparation was made by the Secretary under the direction of Dr. Elkin, and with his assistance and that of Mr. Hall, both of these gentlemen being prevented from undertaking these observations by their Heliometer work. Dr. Elkin prepared the reduced list and checked the positions—which had been calculated for the position of the Atheneum, on the college campus, whose latitude and longitude are given in all the Nautical Almanacs yet issued, as those of Yale

Digitized by Google

Observatory. Semi-circular disks of dull black paper were inserted in the focal plane of the eye-pieces to cut off all but the small segment of the moon's disk, where immersion or emersion was to take place. Mr. W. W. Ellsworth called the settings and times, and recorded the observations. The thermometer stood at $-2°$ Fahr. The clamp and slow motion in declination were disordered and were disconnected, and the moon followed entirely by hand. Until about $11^h\ 40^m$, G. M. T., the moon was only occasionally glimpsed through thin clouds. When these cleared away the edge of the moon was of a bright copper red, and its light too bright for the observation of the fainter stars of the list. Only four observations were made, and these so unsatisfactory on account of the light and clouds, that it was not deemed worth while to communicate them to Director Struve.

The contributions to the Library of the Observatory during the year ending June 1, 1888, have been as follows:

Office of the American Ephemeris. American Ephemeris and Nautical Almanac for the year 1890. 8°. (2 copies). *Washington*, 1887.

Prof. H. A. Newton. American Meteorological Journal, Vol. IV, in numbers. 1887–8. 8°. *Ann Arbor*, 1887–8.

The Observatory. Almanaque Náutico, para el Año 1888. Calculado de Orden de la Superioridad en el Instituto y Observatorio de Marina de la Cuidad de San Fernando. 8°. *Madrid*, 1886.

——— ——Para el Año 1889. *Madrid*, 1887.

The Commission. Berlin. Die Venus-Durchgänge 1874 und 1882. Bericht über die Deutschen Beobachtungen. Im Auftrage der Commission für die Beobachtung des Venus-Durchgangs herausgegeben von A. Auwers. IV^{ter} Band. Die Heliometrischen Arbeiten zur Vorbereitung der Expeditionen und zur Untersuchung der benutzten Instrumente. 4°. *Berlin*, 1887.

The Observatory. Blue Hill Meteorological Observatory. Results of Observations in the year 1886, under the Direction of A. Lawrence Rotch. 4°. *Boston*, 1887.

The Regents. California, University of. List of Recorded Earthquakes in California, Lower Califor-

Digitized by Google

nia, Oregon and Washington Territory. Compiled from Published Works and from Private Information, by Edward S. Holden. 8°. *Sacramento*, 1887.

Cambridge. The Astronomical Observatory of Harvard College. Forty-second Annual Report of the Director, Edward C. Pickering. 8°. *Cambridge*, 1887. — The Observatory.

——————Boyden Fund Circular No. 2. 4°. *Cambridge*, 1887. ——

——Annals of the Astronomical Observatory of Harvard College, vol. XIII, Pt. II, Zone Observations with the Transit Wedge Photometer during the years 1882–6, under the Direction of Edward C. Pickering, Director. 4°. *Cambridge*, 1880. ——

——————Vol. XV, Part I. Catalogue of 1213 Stars observed with the Meridian Circle during the years 1870 to 1879, and prepared for Publication under the Direction of Joseph Winlock and Edward C. Pickering, successive Directors, by William A. Rogers. 4°. *Cambridge*, 1886. ——

——————Vol. XVII. The Almucantar, An Investigation made at the Observatory in 1884 and 1885, by S. C. Chandler, Jr. 4°. *Cambridge*, 1887. ——

——————Vol. XVIII, Nos. I and II. 4°. *Cambridge*, 1887. ——

Cambridge [England]. Annual Report of the Library Syndicate. 4°. *Cambridge*, 1887. The Library.

Canada, Meteorological Service of the Dominion of——. For the year ending December 31, 1884. By Charles Carpmael, Superintendent. 8°. *Ottawa*, 1887. The Superintendent.

——————Monthly Weather Review. January —March, 1888. 4°. *Toronto*, 1888. The Director.

Chicago Astronomical Society. Annual Reports of the Board of Directors together with the Report of the Director of the Dearborn Observatory, for 1885 and 1886; with Papers by Profs. Safford (Nebulæ), Colbert (Lunar The Society.

Digitized by Google

Apsides and Sirius), and Hough (Double Star Catalogue and Printing Chronograph). 8°. *Chicago*, 1887.

The Author. Döllen, W. Stern-Ephemeriden auf das Jahr 1888, zur Bestimmung von Zeit und Azimut mittelst des tragbaren Durchgangsinstruments im Verticale des Polarsterns. 8°. *St. Petersburg*, 1887.

The Observatory. Dorpat. Beobachtungen der Kaiserlichen Universitäts-Sternwarte, 17er Band. Reducirte Beobachtungen am Meridiankreise von Zonensternen und mittlere Oerter derselben für 1875.0. Dr. Ludwig Schwarz. 4°. *Dorpat*, 1887.

The Author. Dreghorn, Lord. Copyright and Patents for Inventions. 2 Vols. 8°. *Edinburgh*, 1883.

——— ——— ———Verities in Verses. 8°. *London*, 1888.

The Earl of Crawford and Balcarres. Dun Echt. Observatory Circulars No. 123–155. *Dun Echt*, 1886–7–8.

The Author. Dunsink. Astronomical Observations and Researches made at the Observatory of Trinity College, Dublin. Sixth Part, Mean Places of 1012 Southern Stars and a few others. Reduced from Observations made with the Meridian Circle at Dunsink, by A. A. Rambaut. 4°. *Dublin*, 1887.

The Institute. Franklin Institute. Journal, Nos. 739 to 744. 8°. *Philadelphia*, 1887.

The Observatory. Geneva. Rapport sur le Concours pour le réglage des Chronomètres pendant l'année 1887. Présenté à la Société des Arts, le 19 Mars 1888, par M. Em. Gautier. 8°.

The Observatory. Greenwich. Astronomical and Magnetical and Meterological Observations made at the Royal Observatory in the year 1885 under the direction of W. H. M. Christie. 4°. *London*, 1887.

——— ———Rates of Chronometers on Trial for purchase by the Board of Admiralty at the Royal Observatory, Greenwich. 4°. *London*, 1886–7

Digitized by Google

——Assumed Mean Right Ascensions of Clock Stars, with the Corrections to the R. A. of the Nautical Almanac for 1888, January 1. 4°. [*London*], 1887.	The Observatory.
——Numerical Lunar Theory, by Sir George Biddell Airy, Late Astronomer Royal. 4°. *London*, 1886.	——
——Transit of Venus, 1882. Report of the Committee appointed by the British Government to superinted the arrangements, &c. Roy. 8°. *London*, 1887.	The Lords of the Treasury.
Havana. Observaciones Magnéticas y Meteorológicas del Real Colegio de Belen de la Compañia de Jesus. 4°. [3 Nos., Oct. 1885 to June, 1886. *Havana*, 1886–7.	The College.
Jewelers' Circular and Horological Review. Numbers to May, 1888. 4°. *New York*, 1887–88.	The Publishers.
La Plata. Anuario del Observatorio para el año 1888. 16mo *Buenos Aires*, 1887.	The Observatory.
Lick Observatory Time Service; by James E. Keeler. 8°.	The Observatory.
Madrid. Real Academia de Ciencias Exactas, Físicas y Naturales. Roy. 8°. *Madrid*, 1887. Memorias, Tomo XII. Estudio Elemental Teórico-práctico de las Máquinas Dinamo-Eléctricas.	The Academy.
—— ——Tomo XIII, Parte 1ª, Cuestiones Biológico-ontogénicas y Fisiológicas sobre los Afidios.	——
—— ——Revista de Ciencias, Tomo 22, No. 4°.	——
Marth, A. Ephemeris for Physical Observations of Mars, 1888. 8°. *London*, 1888.	The Author.
——On the Formulæ for Computing the Apparent Positions of a Satellite, and for Correcting the Assumed Elements of its Orbit. 8°. *London*, 1887.	——
——On the Formulæ for Correcting the Approximate Elements of the Orbits of Binary Stars. 8°. *London*, 1887.	——
Milan. Pubblicazioni del Reale Osservatorio di Brera. 4°.	The Observatory.

Digitized by Google

The Observatory. No. VI. Corrispondenza Astronomica fra Giuseppe Piazzi e Barnaba Oriani. *Milan*, 1874.

——— ——No. VII, Parte II. Osservazioni di Stelle Cadenti fatte dai Membri dell' Associazione Meteorica Italiana durante l'anno 1871. *Milan*, 1885.

——No. XXVII. Osservazioni Meteorologiche Orarie ottenute da Strumenti Registratori durante l'anno 1882. Rilevate e calcolate da Celso Fornioni. *Milan*, 1885.

——— ——No. XXIX. Operazioni eseguite nell 'anno 1881, per determinare la differenza delle Longitudini fra gli Osservatori del Dépot Général de la Guerre à Montsouris presso Parigi, del Mont Gros presso Nizza, di Brera in Milano dai Signori Colonnello F. Perrier, Direttore I. Perrotin, Prof. G. Celoria. Resoconto delle Operazioni fatte da Giovanni Celoria. *Milan*, 1887.

——— ——No. XXX. Determinazione della Latitudine della Stazione Astronomica di Termoli mediante Passaggi di Stelle al Primo Verticale. Memoria di Francesco Porro. *Milan*, 1887.

——— ——No. XXXI. Azimut Assoluto del Segnale Trigonometrico del Monte Palanzone sull' Orizzonte di Milano, determinato nel 1882 da Michele Rajna. *Milan*, 1887.

——— ——No. XXXII. Nuova Triangolazione della Cittá di Milano eseguita dall 'Ing. Francesco Borletti. *Milan*, 1887.

The Academy. National Academy of Sciences. 8°. Vol. I. *Washington*, 1866.

——— ——Vol. II. *Washington*, 1884.

——— ——Vol. III, Parts 1 and 2. *Washington*, 1885–6.

The Superintendent. Nautical Almanac. Report of the Superintendent for the year ending June 30, 1887. *Washington*, 1887.

The Lords Commissioners of the Admiralty. Nautical Almanac and Astronomical Ephemeris for the year 1891, for the Meridian of the Royal Observatory at Greenwich. 8°. *London*, 1887.

Digitized by Google

Den Norske Gradmaalingskommission, Vandstandsobservationer. IV. Hefte. 4°. *Christiania*, 1887. — The Commision.

Norwegisches Meteorologisches Institut. Jahrbuch für 1885. 4°. *Christiania*, 1886. — Royal University of Norway.

——Commission der Europæischen Gradmessung. Geodätische Arbeiten. Heft V. 4°. *Christiania*, 1887. — The Commission.

Oxford. Radcliffe Observatory. Results of Astronomical and Meteorological Observations made in the year 1884, under the superintendence of Edward James Stone. Vol. XLII. 8°. *Oxford*, 1887. — The Observatory.

Peters, C. H. F. Flamsteed's Stars. "Observed but not existing." [National Acad. of Sci., Vol. III, 10th Memoir.] 4°. *Washington*, 1885. — The Author.

——Corrigenda in various Star Catalogues. [National Acad. of Sci., Vol. III, 11th Memoir.] 4°. *Washington*, 1885. — ——

Pickering, E. C. Observations of Variable Stars in 1886. [Proc. Am. Acad. of Arts and Sci., Vol. XXII.] 8°. *Cambridge*, 1887. — The Author.

Prague. K. K. Sternwarte. Magnetische und Meteorologische Beobachtungen im Jahre 1886. L. Weinek, Director. 4°. *Prague*, 1887. — The Observatory.

Puebla, Estado de——. Boletin Estadistica. Tomo I, Num. 1—38. Folio. *Zaragoza*, 1887–8. — The Commission.

Rome. Museo Copernicano ed Astronomico. Brevi Notizie sull 'Impianto. 8°. *Bologna*, 1887. — The Museum.

——Reale Academia dei Lincei. Anno cclxxviii (1880–81). Osservazioni Astronomiche e Fisiche sull' Asse di Rotazione e sulla Topografia del Pianeta Marte, fatte nella Reale Specola di Brera in Milano, coll' Equatoriale di Merz. Memoria Seconda del Socio G. V. Schiaparelli, (Osservazioni dell' Opposizione 1879–1880.) 4°. *Rome*, 1881. — The Academy.

—— —— Anno cclxxxiii, 1885–86. Memoria Terza. (Opposizione 1881–1882.) *Rome*, 1886. — ——

Digitized by Google

The Observatory. Tacubaya. Observatorio Astronómico Nacional. Anuario para el año de 1888. Ángel Anguiano. Año viii. 12°. *México*, 1887.

——Longitud del Observatorio Astronómico Nacional Mexicano por Señales telegráficas cambiadós directamente entre St. Louis, Missouri (E. U. de A.) y Tacubaya. Memoria que escribió y presenta á la Secretaría de Fomento el Ingeniero Ángel Anguiano, Director. 8°. *México*, 1886.

The Institute. Toronto. Canadian Institute. [Vol. V, fasciculi 1 and 2.] Proceedings. October, 1887 and April, 1888. 8°. *Toronto*, 1887–8.

—— ———Session 1886–7 being Part of Appendix to the Report of the Minister of Education. 8°. *Toronto*, 1887.

The Academy. Vienna. Kaiserliche Akademie der Wissenschaften. Circulars Nr. LXI—LXVI. 8°. *Vienna*, 1886–7.

THE THERMOMETRIC BUREAU.

Mr. Peck has continued to make the comparisons of thermometers, and has introduced appliances for expediting his work, while securing greater accuracy in reading.

The general improvement noted last year in the accuracy of clinical thermometers received for comparison is still maintained. While these are, for each maker, presumably his best work, it is quite probable that the entire manufacture shares in the improvement, so that the usefulness of the Bureau is not justly measured by the mere number of instruments which pass through our hands. In the number certified there has been an increase of 1012 over last year and of 844 over the largest previous annual number, as shown by the following table.

Digitized by Google

Instruments received for certification during the years ending

June 1, 1881,	1,946
June 1, 1882,	4,533
June 1, 1883,	5,324
June 1, 1884,	6,392
June 1, 1885,	5,717
June 1, 1886,	6,355
June 1, 1887,	6,224
June 1, 1888,	7,236
Total,	43,727

ROBERT BROWN,

Secretary of the Observatory.

Digitized by Google

REPORT OF DR. ELKIN.

YALE UNIVERSITY, June 7, 1888.

To the Board of Managers of the Observatory:

GENTLEMEN:—Since my last report the series of observations on the parallaxes of the ten stars of the first magnitude in the Northern Hemisphere has been brought to a close. It may seem worth while to mention in brief here the results arrived at, in advance of their detailed publication in our Transactions. They are as follows:—

Star.	Parallax.	Prob. Error.	No. of Comp. stars.	No. of obs.	Proper Motion.
α Tauri,	+0.″116	±0.″029	6	64	0.″202
α Aurigae,	+0.107	0.047	2	16	0.442
α Orionis,	−0.009	0.049	2	16	0.022
α Canis minoris,	+0.266	0.047	2	16	1.257
β Geminorum,	+0.068	0.047	2	16	0.628
α Leonis,	+0.093	0.048	4	15	0.255
α Bootis,	+0.018	0.022	10	89	2.287
α Lyrae,	+0.034	0.045	2	30	0.344
α Aquilae,	+0.199	0.047	4	16	0.647
α Cygni,	−0.042	0.047	4	16	0.010

The probable errors here given include an estimation of the probable *systematic* error of the measures, derived from the agreement of the independent results from the several pairs of comparison stars where more than one such has been employed. They are therefore considerably larger than those generally assigned to such results, which, as a rule, only take into account the mere *casual* error of observation.

It will be seen on inspection of the table that of the ten stars six may be said to give indications of a measurable parallax, but in only two cases are the values in any degree remarkable. These are those for α Canis Minoris and α Aquilae, and it is worth while to note that they confirm closely results of former investigators, namely those of Auwers and Wagner on Procyon, which gave +0.″240 ±0.″029 and +0.″299 ±0.″038 respectively, and that of W. Struve at Dorpat on Altair, which gave +0.″181 ±0.″094. On the other hand my next two largest results, those for Aldebaran and Capella do not confirm the large values found by O. Struve at Pulkowa, which were +0.″516 ±0.″057 and +0.″305 ±0.″043. In the case of the former star I am, however, in close agreement with Hall at Washington,

Digitized by Google

who found +0.″102 ±0.″030, and there seems to be but little doubt that the Pulkowa value is largely in error. There have been no results of any importance derived hitherto for Pollux and Regulus, the remaining two of the six stars where the effect of parallax is at all sensible.

Of the four stars where the parallactic displacement has been inappreciable, Arcturus, with its large proper motion of over 2,″ second only to that of α Centauri in all of the 200 brightest stars down to the fourth magnitude, is especially noteworthy. The minuteness of the parallax is beyond doubt, depending as it does on five pairs of comparison stars, all in reasonable agreement, and it cannot be considered as seriously at variance with the results previously obtained by Peters and Johnson, +0.″127 ±0.″073 and +0.″138 ±0.″052 respectively, when their liability to systematic error is duly taken into account. For α Orionis and α Cygni, in view of their extremely small proper motions, the insensibility of their parallaxes is not surprising. The Yale result for α Lyrae, however, does not fall in well with those which have been hitherto deduced for this star. If we commence at the epoch of W. Struve and neglect the earlier attempts to find the absolute parallax, we have the following list of values :—

W. Struve at Dorpat, 1837–40,	+0.″261	±0.″025
Peters at Pulkowa, 1842,	0.103	0.053
O. Struve at Pulkowa, 1851–53,	0.147	0.009
Johnson at Oxford, 1854–55,	0.154	0.046
Brünnow at Dublin, 1868–69,	0.212	0.010
Brünnow at Dublin, 1870,	0.188	0.033
Hall at Washington, 1880–81,	0.134	0.0055

from which a parallax of about +0.″17 would seem well assured. The pair of comparison stars used here is very symmetrical and so large a value would seem incompatible with the Heliometer measures ; I hope, however, to be able to trace the discordance to its source.

In planning this work the object in view was the determination of the average or mean parallax of the stars of the first magnitude, and in pursuance of this I may state that the mean of the 10 values above given is

+0.″085 ±0.″015,

to which should probably be added +0.″004 as the probable parallax of the comparison stars which are in the mean of about the eighth magnitude, giving

Digitized by Google

+0.″089 ±0.″015

for the result sought for. I do not, however, in view of the wide range of distance implied by the values of the above table, feel at all certain that this result may be taken as a measure of the average distance of the stars in question, and at all events it must be considered only as provisional and partial until it can be combined with the result for the first magnitude stars of the Southern Hemisphere, now in course of determination by Dr. Gill. At the same time I might draw attention to its near coincidence with the values derived by Gyldén (0.″084) and Peters (0.″102)—without, however, wishing to lay too much stress on this agreement.

The Heliometer is now being employed in a triangulation of the stars in the vicinity of the North Pole. Early in the year Prof. Pickering, of Harvard, applied to us to determine the relative places of a few stars to serve as fundamentals for a catalogue of the stars within 1° of the Pole by photographic methods. I have concluded to enlarge the plan originally laid out for this purpose, and am now observing 24 stars within 100′ of the Pole, nearly all that are measurable with the Heliometer in that area. The work is well under way, but as a considerable portion of the months of October, November and December are to be devoted to the joint observation with Dr. Gill of the extremely favorable opposition of Iris for a determination of the solar parallax, it may not be completed before next year.

Mr. Hall has been steadily occupied with the reduction of his measures on Titan, which is now approaching completion. In this connection he has made an extensive series of measures on the division errors of the parts of the scale in use therefor. He has also taken up for investigation of their parallaxes the stars 6 B. Cygni and 18115/22 Lalande, both of which present especial interest.

The series of measures of the Sun's diameter has been continued, a special research having been undertaken on the influence of different apertures upon the same, and upon the scale value. We have also made some measures of the diameter of Mars at its late opposition and of various double stars.

Respectfully,

W. L. ELKIN,

Astronomer in charge of the Heliometer.

Digitized by Google

Educ R560.3.15

Sci 972.5
Yr

Report for the Year 1888–89, presented by the Board of Managers of the Observatory of Yale University to the President and Fellows.

Digitized by Google

HARVARD COLLEGE
AUG 7 1889
LIBRARY
By Mail

OBSERVATORY OF YALE UNIVERSITY.

BOARD OF MANAGERS.

Rev. TIMOTHY DWIGHT, D.D., LL.D., *President.*
Professor ELIAS LOOMIS, LL.D.
Professor CHESTER S. LYMAN, M.A.
Professor HUBERT A. NEWTON, LL.D., *Secretary.*
THOMAS G. BENNETT, PH.B.
Professor CHARLES S. HASTINGS, PH.D.

OFFICERS.

ROBERT BROWN, M.A., *Secretary.*
WILLIAM L. ELKIN, PH.D., *Astronomer in charge of the Heliometer.*
ASAPH HALL, Jr., *Assistant Astronomer.*

Digitized by Google

REPORT.

YALE UNIVERSITY, June 24, 1889.

To the President and Fellows of Yale University:

GENTLEMEN:—We herewith present to you the Report of the Secretary of the Observatory, and that of the Astronomer in charge of the Heliometer.

The time service has been throughout the year under the care of Mr. Hall the Assistant Astronomer.

The Board expresses its sense of the loss which the Observatory suffered in the death, January 14, of one of our number, Jacob Campbell, Esq., of New York City. Mr. Campbell was one of the Trustees selected by Mr. Winchester in 1872, and upon the transfer of the Observatory to the College, Mr. Campbell was made one of the Board of Managers. Whenever his health and business permitted he attended the meetings of the Trustees and of the Board, and he was deeply interested in the plans and work of the Observatory. For the development of these he made repeated and generous donations.

Respectfully submitted by

THE BOARD OF MANAGERS.

Digitized by Google

SECRETARY'S REPORT.

YALE OBSERVATORY, June 18, 1889.

To the Board of Managers:

GENTLEMEN:—I have the honor to report that during the year ending June 1, 1889, improvements of the Observatory grounds have been effected as follows:

1. In the south sidewalk of Highland street elm trees have been planted, in continuation of the former year's planting, from Prospect street to St. Ronan street, excepting at three points where a little blasting will be necessary, to be done as the season permits.

2. In the west sidewalk of St. Ronan street a short distance south of Highland street, five elm trees have been planted—all that the present grade of the ground would justify. Since the season passed for planting, the city has been doing something toward the grading of St. Ronan street, by removing all the earth, down to the rock, and between curb lines, from that portion of the street extending about five hundred feet north from Canner* street, to fill that portion next south of Canner street. At about midway from Canner street to Highland street there will be a further cut, through rock, of two or three feet, gradually lessening in either direction for an average distance of one hundred feet or more. St. Ronan street is thus opened to travel from Canner street southward to its intersection with Lawrence street. A fill of about 800 yards, is thus made necessary in the lot on the southwest corner of Canner and St. Ronan streets. Our side of St. Ronan street, northward from Canner street, will present about 900 feet of beautifully situated and well drained lots, in every way desirable for building purposes, containing handsome well-grown beeches, oaks and other native forest trees, and within 500 feet of the Whitney Avenue street cars. The cut which the city has made will facilitate the extension of the line of shade trees in the west sidewalk, which I hope to complete in the

*I here and in recent reports, conform to the city's official spelling of this name, as it is pronounced, rather than adhere, as in earlier reports, to the original spelling.

Digitized by Google

coming Fall and Spring, thus attaining the aggregate of 6,000 feet of frontage planted with shade trees from the beginning in 1883.

3. On the north side of Canner street the sidewalk has been graded for the full width in that portion which required excavation, the city taking all the earth which we could spare to replace that washed from the adjacent street, and to raise the grade of the street eastward. About 300 yards of filling will be required to complete this sidewalk to St. Ronan street, when the entire frontage will present an attractive appearance.

4. Within the Observatory reservation a few additional trees have been planted in the northwest corner, and some of former plantings which did not thrive have been replaced. A limited nursery of small sugar and Norway maples, oaks, elms, etc., has been planted with regard to our future requirements.

The number of visitors to the Observatory has been larger than formerly, probably because it has been more frequently practicable than in working Observatories generally, to exhibit the various objects of popular interest. No record has been kept of such occasions, nor of the rarer, yet not infrequent, calls of astronomers of note from all parts of the world.

The contributions to the Library of the Observatory during the year ending June 1, 1889, have been as follows:

American Ephemeris and Nautical Almanac for the year 1891. 8°. (2 copies). *Washington*, 1888.	Office of the Am. Eph. and Naut. Almanac.
American Meteorological Journal, Vol. V, in numbers. 1888–9. 8°. *Ann Arbor*, 1888–9.	Prof. H. A. Newton.
Almanaque Náutico, para el Año 1890. Calculado de Orden de la Superioridad en el Instituto y Observatorio de Marina de la Cuidad de San Fernando. 8°. *Madrid*, 1888.	The Observatory.
Bailly, J. S. Histoire de l'Astronomie Moderne; Nouvelle édition. 3 vols. 4° *Paris*, 1785.	Prof. H. A. Newton.
——Histoire de l'Astronomie Ancienne; Seconde édition. 4°. *Paris*, 1781.	——
——Histoire de l'Astronomie Indienne et Orientale. 4°. *Paris*, 1787.	——

Digitized by Google

The Author. Battermann, H. Untersuchungen über die Gestalt der Bilder und die Theorie der Messungen ausserhalb der optischen Axe von astronomischen Instrumenten. Mit specieller Berücksichtigung des Heliometers mit ebener Führung. [Abdr. Astr. Nachr., Bd. 120.] 4°. *Kiel*, 1889.

——— ——Beiträge zur astronomischen Aberrationslehre. *Berlin*, 1881.

The Commission. Berlin. Die Venus-Durchgänge 1874 und 1882. Bericht über die Deutschen Beobachtungen. Im Auftrage der Commission für die Beobachtung des Venus-Durchgangs herausgegeben von A. Auwers. II^ter Band. Die Beobachtungen der Expeditionen von 1874. 4°. *Berlin*, 1889.

——— ——— ———III^ter Band. Die Beobachtungen der Expeditionen von 1882. 4°. *Berlin*, 1888.

The Observatory. ——Königl. Sternwarte. Beobachtungs-Ergebnisse, Heft No. 1. Resultate aus Beobachtungen von 521 Bradley'schen Sternen. Dr. E. Becker. 4°. *Berlin*, 1881.

——— ——— ———Heft No. 2. Resultate aus Beobachtungen von 670 Sternen angestellt in den Jahren 1885 und 1886. Dr. F. Küstner. 4°. *Berlin*, 1887.

——— ——— ———Heft No. 3. Neue Methode zur Bestimmung der Aberrations — Constante, nebst Untersuchungen über die Veränderlichkeit der Polhöhe. Dr. F. Küstner. 4°. *Berlin*, 1888.

——— ——— ———Heft No. 4. Ableitung der Rectascensionen der Sterne des Fundamental-Cataloges der Astronomischen Gesellschaft aus den von H. Romberg in den Jahren 1869–1873. . . angestellten Beobachtungen. Dr. A. Marcuse. 4°. *Berlin*, 1888.

The Author. Bredichin, Th. Sur l'Origine des Étoiles Filantes. 8°. [Extrait du Bulletin de la Soc. Impér. des Naturalistes de Moscou. 1889. No. 1.] *Moscow*, 1889.

Digitized by Google

Bredichin, Th. Sur l'Origine des Comètes Périodiques. 8°. [Extrait du Bulletin de la Soc. Impér. des Naturalistes de Moscou. 1889. No. 2.] *Moscow*, 1889. — The Author.

Boston. American Academy of Arts and Sciences. Proceedings. New Series. Vol. XV, Pt. 1. 8°. *Boston*, 1888. — The Academy.

Cambridge. Annals of the Astronomical Observatory of Harvard College. Vol. XVIII, 4°. *Cambridge*, 1888. — The Observatory.

No. III. Photometric Observations of Asteroids. By Henry M. Parkhurst. — ——

——No. IV. Total Eclipse of the Moon, Jan. 28, 1888. — ——

——No. V. Total Eclipse of the Sun, Aug. 29, 1886. By William H. Pickering. — ——

——No. VI. Detection of New Nebulae by Photography. — ——

——No. VII. A Photographic Determination of the Brightness of the Stars. 1889. — ——

——No. VIII. Index to Observations of Variable Stars. [1889.] — ——

——Vol. XX, Part I. Observations of the Blue Hill Meteorological Observatory, in 1887, etc. A. Lawrence Rotch. 4°. *Cambridge*, 1889. — ——

——The Astronomical Observatory of Harvard College. Forty-third Annual Report of the Director, Edward C. Pickering. 8°. *Cambridge*, 1888. — ——

——Henry Draper Memorial. Second Annual Report of the Photographic Study of Stellar Spectra. Edward C. Pickering, Director. 4°. *Cambridge*, 1888. — ——

——Third Annual Report of the Photographic Study of Stellar Spectra. Edward C. Pickering. 4°. *Cambridge*, 1889. — ——

Canada, Meteorological Service of the Dominion of——. For the year ending December 31, 1885. By Charles Carpmael, Superintendent. 8°. *Ottawa*, 1888. — The Superintendent.

Digitized by Google

The Director. Canada———Monthly Weather Review. April, 1888—March, 1889. 4°. *Toronto*, 1888–9.

The Observatory. Cape of Good Hope. Royal Observatory Annals. Vol. II, Pt. II. Variation of the instrumental adjustments of the Cape Transit Circle. By W. H. Finlay. 4°. [*London*, 1885?]

——— ——— ———Results of Meridian Observations made during the years 1882–3–4, and till 1885, February 8, under the direction of David Gill, Astronomer Royal. 8°. *London*, 1887.

The Author. Chandler, S. C. Catalogue of Variable Stars [Astron. Jour., Nos. 179, 180]. 4°. *Lynn.*

The Society. Chapel Hill, N. C. Elisha Mitchell Scientific Society. Journal, Vol. IV, Part II. 8°. *Raleigh*, 1887.

——— ——— ———Journal, Vol. V, Part I. 8°. *Raleigh*, 1888.

The Observatory. Christiania. Zonenbeobachtungen der Sterne zwischen 64° 50′ und 70° 10′ nördlicher Declination auf der Universitäts-Sternwarte in Christiania. C. Fearnley and H. Geelmuyden. 4°. *Christiania*, 1888.

The Author. Döllen, W. Stern-Ephemeriden auf das Jahr 1889. 8°. *St. Petersburg*, 1888.

The Earl of Crawford and Balcarres. Dun Echt. Observatory Circulars No. 156–170. *Dun Echt*, 1888–9.

The Author. Edinburgh. Report on the Royal Observatory, and the Edinburgh Equatorial in 1887. C. Piazzi Smyth. 4°. [*Edinburgh*] 1888.

The Observatory. Greenwich. Royal Observatory. Astronomical and Magnetical and Meteorological Observations made in the year 1886 under the direction of W. H. M. Christie. 4°. *London*, 1888.

——— ——— ———Rates of Chronometers on Trial for purchase by the Board of Admiralty. 4°. *London*, 1888.

——— ——— ———Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, read at the Annual Visita-

Digitized by Google

tion of the Royal Observatory, 1888, June 2. 4°. *London*, 1888.

Greenwich———Assumed Mean Right Ascensions of Clock Stars, with the corrections to the R. A. of the Nautical Almanac for 1889, January 1. [*London*] 1888. — The Observatory.

Havana. Observationes Magnéticas y Meteorológicas del Real Colegio de Belen de la Compañía de Jesus. 4°. [3 Nos., July, 1886, to June, 1887.] *Havana*, 1888–9. — The College.

Hong Kong. Observations made at the Observatory in the year 1887, by W. Doberck, Director. 4°. *Hong Kong*, 1888. — The Observatory.

de Humboldt, A. Voyage de Humboldt et Bonpland, quatrième partie. Astronomie. Receuil d'Observations Astronomiques. 2 vols., folio. *Paris*, 1810. — Prof. H. A. Newton.

Hutchins, C. C., and Daniel Edward Owen. An Account of a new Thermograph, and of some Measures of Lunar Radiation. [Proc. Am. Acad. Arts and Sci. Vol. XXIV.] 8°. [*Boston*, 1889.] — The Authors.

Jewelers' Circular and Horological Review, June, 1888–May, 1889. Vol. XIX, No. 5, to Vol. XX, No. 4. 4°. *New York*, 1888. — The Publishers.

Kiel. Publicationen der Sternwarte. Das Æquinoctium für 1860.0. Abgeleitet aus den von Dr. C. T. Pape . . in den Jahren 1859–62 angestellten Sonnenbeobachtungen. Dr. E. Lamp. 4°. *Kiel*, 1882. — The Observatory.

——— ———Untersuchungen über das Cometensystem, 1843 I, 1880 I und 1882 II. 1 Theil. Der grosse September Comet 1882 II. Dr. Heinrich Kreutz. 4°. *Kiel*, 1888. — ———

de La Lande, J. Astronomie, Seconde édition, 3 vols. 4°. *Paris*, 1771. — Prof. H. A. Newton.

M. Loewy. Notice sur la vie et les travaux de M. Oppolzer. 8° [Extr. du Bulletin Astronomique, Janvier 1887]. *Paris* [1887]. — The Author.

Madras. Results of the Observations of the Fixed Stars . . at the Government Observa- — Dr. W. L. Elkin.

Digitized by Google

tory, Madras, in the years 1862, 3 and 4 Norman Robert Pogson. 4°. *Madras*, 1887.

Dr. W. L. Elkin. Madras ———in the years 1865, 6 and 7. 4°. *Madras*, 1888.

——— Marth, A. Ephemerides of the Satellites of Saturn and Neptune, 1888–9 [Reprint from Mo. Not. R. A. S. Vol. XLVIII, No. 9]. *London*, 1888.

——— ——Ephemeris for Physical Observations of the Moon, 1889. Ephemerides of the Satellites of Saturn, 1888–9 (continued). [Reprints from Mo. Not. R. A. S. Vol. XLIX, No. 1.] *London*, 1888.

——— ——Ephemeris for Physical Observations of Jupiter 1889. 8° [Reprint from Mo. Not. R. A. S. Vol. XLIX, No. 2]. [*London*] 1888.

——— ——Ephemeris for Physical Observations of the Moon. Ephemeris of the Satellites of Uranus 1889. [Reprint from Mo. Not. R. A. S. Vol. XLIX, No. 3.] [*London*] 1889.

The Publishers. Medical and Surgical Journal. August, 1888–May, 1889. Vol. XXVIII, Nos. 1–10. 8°. *Buffalo*, 1888.

The Observatory. Mexico. Observatorio Meteorológico-Magnético Central. Boletin Mensual. Tomo I, Núm. 1–5, January–May, 1888. 4°. *Mexico*, 1888.

Prof. H. A. Newton. Mendosa Rios, J. A complete collection of Tables for Navigation and Nautical Astronomy. 4°. *London*, 1805.

The Observatory. Milan. Pubblicazioni del Reale Osservatorio di Brera. 4°.

No. XXXIII. Stelle Doppie. Serie Prima, Comprendente le Misure di 465 Sistemi. . . negli anni 1875–1885. G. V. Schiaparelli. 4°. *Milan*, 1888

——— ———No. XXXIV. Sulla Distribuzione Apparente delle Stelle visibili ad Occhio nudo. G. V. Schiaparelli. 4°. *Milan*, 1889.

——— Montsouris. Observatoire Municipal. Annuaire pour l'an 1888. 12°. *Paris*, 1888.

Digitized by Google

Moscow. Annales de l'Observatoire. 2me Série. Vol. I. 2me livraison. Th. Bredichin. 4°. *Moscow*, 1888.	The Observatory.
H. A. Newton. Upon the relation which the former orbits of those Meteorites that are in our collections, and that were seen to fall, had to the Earth's Orbit. [Reprint from Am. Jour. Sci. Vol. XXXVI, No. 211, July, 1888.] [*New Haven*] 1888.	The Author.
Padua. Atti e Memorie della R. Accademia di Scienze, Lettere ed Arti. 8°. Anno CCLXXXVI (1884–85), Nuova Serie. Vol. I. *Padova*, 1885.	The Academy.
——— ———Anno. CCLXXXVII (1885–6), Nuova Serie. Vol. II. *Padova*, 1886.	———
——— ———Anno. CCLXXXVIII (1886–7), Nuova Serie. Vol. III. *Padova*, 1887.	———
Paris. Connaissance des Temps. Pour l'an 1889. 8°. *Paris*, 1887.	The Bureau of Longitudes.
——— ———Pour l'an 1890. 8°. *Paris*, 1888.	———
——— ———Extrait à l'usage des Écoles d'Hydrographie et des Marins du Commerce pour l'an 1889. 8°. *Paris*, 1887.	———
——— ———Pour l'an 1890. 8°. *Paris*, 1888.	———
———Annuaire pour l'an 1888. 12°. *Paris* [1887].	———
——— ———Pour l'an 1889. 12°. *Paris* [1888].	———
———Éphémérides des Étoiles de Culmination Lunaire et de Longitude pour 1888. M. Loewy. 4°. *Paris*, 1887.	———
——— ———Pour 1889. 4°. *Paris*, 1888.	———
———Enquêtes et Documents relatifs à l'Enseignement Supérieur. XXIV. Rapport sur les Observatoires Astronomiques de province. M. Loewy. 8°. *Paris*, 1887.	———
———Académie des Sciences. Étude de la flexion horizontale de la lunette du Cercle Méridien Bischoffsheim de l'Observatoire de Paris. MM. Loewy, Leveau et Henri Renan. 4°. [Extr. des Comptes Rendus. Tome CIV, 17 Janvier 1887.] *Paris* [1887].	———

Digitized by Google

The Bureau of Longitudes. Paris ———Nouvelles Méthodes pour la détermination de la constante de l'aberration. M. Loewy. 4°. [Extr. des Comptes Rendus. Tome CIV and CV.] *Paris*, 1887.

——— ——— ———Théories Nouvelles de l'Équatorial Coudé et des Équatoriaux en général. M. Loewy and M. Puiseux. [Extrait des C. R. Tome CVI.] 4°. *Paris*, 1888.

The Society. Prague. Königl. böhmische Gesellschaft der Wissenschaften. Jahresbericht, 1887. 8°. *Prague*, 1887.

——— ——— ———Sitzungsberichte. Mathematisch-naturwissenschaftliche Classe. Jahrgang 1886. 8°. *Prague*, 1887.

——— ——— ——— ———Jahrgang 1887. 8°. *Prague*, 1888.

——— ——— ———Abhandlungen der Mathematisch-naturwissenschaftlichen Classe vom Jahre 1885–1886. VII Folge, 1 Band. 4°. *Prague*, 1886.

The Observatory. ——K. K. Sternwarte. Magnetische und Meteorologische Beobachtungen im Jahre 1887. L. Weinek, Director. 4°. *Prague*, 1888.

The Commission. Puebla, Estado de—. Boletin Estadistica. Tomo I, Núm. 39–47. Toma II, Núm. 1–3. Folio. *Zaragoza*, 1888.

The Observatory. Pulcova: Observatoire Central Nicolas. Beobachtungen der Saturns-trabanten. Erste Abtheilung: Beobachtungen am 15-Zölligen Refractor. Hermann Struve. Supplément I aux Observations de Poulkova. 4°. *St. Petersburg*, 1888.

——— ——— ———Observations de Poulkova. Vol. XIV. Déduction des Déclinaisons Moyennes du Catalogue des Étoiles Principales pour 1865.0. M. Nyrén. 4°. *St. Petersburg*, 1888

The Observatory. ——Nicolai - Hauptsternwarte. Jahresbericht. 8°. *St. Petersburg*, 1887.

The Academy. Rome. Reale Accademia dei Lincei. (Anno CCLXXX 1882–83) Misure Micrometriche

Digitized by Google

di Stelle Doppie e Multiple fatte negli Anni 1852–1878 dal Barone Ercole Dembowski. Vol. I, Contenente le Osservazioni fatte a Napoli e le Serie Minori osservate a Gallarate. 4°. *Rome*, 1883.

Rome ———(Anno CCLXXX, 1883–4.) Vol. II, Contenente le Osservazioni fatte a Gallarate sopra le Stelle del Catalogo di Dorpat e delle Appendici di W. Struve. 4°. *Rome*, 1884. — The Academy.

Rugby. Report on the Temple Observatory for the year ending 1888. 8°. [*Rugby* 1889]. — The Observatory.

St. Petersburg, Académie Impériale des Sciences. Mémoires. VII^me^ Série, Tome XXXIV. 4°. *St. Petersburg*, 1886. — The Academy.

No. 8. O. Backlund. Comet Encke 1865–1885.

——— ——— ———No. 12. Paul Harzer. Untersuchungen über einen speciellen Fall des Problems der drei Körper. ———

——— ——— ———Tome XXXV, No. 3. Ludwig Struve. Bestimmung der Constante der Praecession und der eigenen Bewegung des Sonnensystems. 1887. ———

——— ———Neue Reduction der Bradley'schen Beobachtungen aus den Jahren 1750 bis 1762. Arthur Auwers. 4°. *St. Petersburg*. 2^ter^ Band. Die Reduction der einzelnen Beobachtungen am Passagen-Instrument und am neuen Quadranten enthaltend. 1882. ———

——— ———3^ter^ Band. Den Stern-Catalog für 1755 und seine Vergleichung mit neuen Bestimmungen enthaltend. 1888. ———

Schumann, Richard. Ueber den Gang der Pendeluhr F. Dencker XII. [Berichte der K. Sächs. Gesellschaft der Wissenschaften. Math.-Phys. Classe]. 8°. [*Leipzig*] 1888. — The Author.

Searle, Arthur. Atmospheric Economy of Solar Radiation [Reprint Proc. Am. Acad. of Arts and Sci.]. 8°. *Boston*, 1888. — The Author.

Digitized by Google

The Institution. Smithsonian Institution. Additions and Corrections to the List of Foreign Correspondents, to July, 1888. By Geo. H. Boehmer. 8°. *Washington*, 1888.

——— ——— ———Systematic Arrangement of the List of Foreign Correspondents, July, 1888, by Geo. H. Boehmer. 8°. *Washington*, 1888.

The Observatory. Tacubaya. Observatorio Astronómico Nacional. Anuario para el año de 1889. Ángel Anguiano. Año IX. 12°. *México*, 1888.

The University. Tōkyō. Imperial University. Calendar for the year 1888–89. 8°. *Tokyo*, 1888.

The Institute. Toronto. Canadian Institute. Proceedings. Vol. VI. 8°. *Toronto*, 1888–9.

The Academy. Vienna. Kaiserliche Akademie der Wissenschaften. Circulars Nr. LXVII, LXVIII. 8°. *Vienna*, 1888–9.

The Observatory. ——Publicationen der v. Kuffnerschen Sternwarte in Wien (Ottakring). Norbert Herz. 4°. *Vienna*, 1889.

The Academy. Washington. National Academy of Sciences. Memoirs. 8°. Vol. IV, Part I. *Washington*, 1869.

The Society. ——Philosophical Society Bulletin. Vol. X, 1887, with Index to the first Ten Volumes. 8°. *Washington*, 1888.

U. S. Government. ——Fiftieth Congress [2d Session]. Official Congressional Directory. W. H. Michael. 2d Edition. Corrected to January 25, 1889. 8°. *Washington*, 1889.

U. S. War Department. ——Register, January 1, 1889. *Washington*, 1889.

The Observatory. Williamstown. Hopkins Observatory of Williams College. The Development of Astronomy in the United States. A Discourse read June 25, 1888, to commemorate the 50th Anniversary of the Dedication of the Observatory. Truman Henry Safford. 8°. *Williamstown*, 1888.

——— ——— ———Williams College Catalogue of North Polar Stars. R. A. for 1885.0. Truman Henry Safford. 4°. *Williamstown*, 1888.

Digitized by Google

In addition to the foregoing gifts to the Library, we have received as follows:

From Messrs. Sardy, Coles & Co., New York City, agents for the patentees and makers, one gilt "Immisch" registering clinical thermometer, illustrating the method of construction and action.

From the Lick Observatory, a glass positive of the solar eclipse of January 1, 1889, taken by Prof. Barnard, which beautifully exhibits the equatorial bands and polar radiations of the corona. This desirable acquisition came to us through Dr. Elkin upon his return from California.

THE THERMOMETRIC BUREAU.

The comparison of thermometers has continued to be made by Mr. C. B. Peck. The number received for verification during the year ending June 1, 1889, was 7,475, being 249 in excess of the preceding, our maximum, year.

It is perhaps well to call public attention to the fact, not new, but continually overlooked, that the most accurate thermometers may be made to give false testimony, by misinterpretation of their language.

Although every certificate issued from this Observatory, for other than clinical thermometers, contains a statement of the only conditions under which the correction therein given can be truthfully applied, we are continually called upon to explain, especially in the case of high temperature thermometers, that when only the bulb is immersed in a liquid of high temperature, the indicated temperature is too low by an amount depending upon the number of degrees of the mercury in the cooler stem and the difference between the temperatures of the bulb and stem. We have been called upon to show frequently that this error, which is independent of any correction due to the thermometer, may be as much as 8° or 9° in the case of high temperature oils, as their temperatures are generally measured. A simple remedy for this indefiniteness of measurement would seem to be a special form of thermometer in which nearly all the mercury should be immersed. As a result of considerable correspondence with parties interested in the accuracy of measurements of this sort, it was suggested

Digitized by Google

that this Observatory should be represented at a convention held last January, but as it did not appear that the expense to the Observatory would be covered by the compensation likely to be received from this class of work, and the funds were wanting to enable us otherwise to render this public service, no encouragement was given to tender the proposed official invitation.

Of the same nature is the correction of possibly 0.°1 to be applied to clinical thermometers of the "Indestructible Index" form, when the detached column of mercury constituting the index is quite long (expressed in degrees) and is read after removal to a much cooler atmosphere. Our comparisons require us to take precaution on this account in the colder days of winter; but any notice of the matter or instructions on the precautions to be taken in using these instruments have been deferred until a new edition of our circular of instructions and conditions should appear to be called for, and this the more readily because the probable error on this account does not exceed the probable error of reading.

Very respectfully,

ROBERT BROWN,

Secretary of the Observatory.

Digitized by Google

REPORT OF DR. ELKIN.

YALE OBSERVATORY, June 10, 1889.

To the Board of Managers of the Observatory:

GENTLEMEN:—During the summer months of 1888 I completed the measures with the Heliometer for the triangulation of the region near the North Pole. The reductions of these measures are well advanced, but as the final adjustment involves the determination of the 48 coördinates of the 24 stars from 144 of their observed intermutual distances, it may require some considerable time yet.

In October we commenced the series of observations on the minor planet Iris in conjunction with the observatories at the Cape and at Leipzig. The autumn months were unfortunately by no means as favorable as usual and we only secured measures on 34 of the 65 planned nights. We undertook at the same time a further series for the diurnal parallax of the planet and the following table shows the total amount of observations obtained, each set consisting of 16 pointings:

Elkin:	Eastern	Observations:	86	Sets on	29	Nights.
	Western	"	23	" "	10	"
Hall:	Eastern	"	31	" "	17	"
	Western	"	28	" "	18	"

We have undertaken here the discussion of the whole series of measures, and have made some progress in comparing the meridian observations of the planet and comparison stars, as well as in the reduction of the Leipzig and Yale Heliometer measures, the former having been kindly forwarded in all detail by Prof. Bruns.

We are now commencing a similar series on the planet Victoria to continue through until September and a third series on Sappho is to occupy us in September and October. As in addition to the Heliometers used for Iris, those at Bamberg and Göttingen will probably coöperate this year, the three series together will doubtless furnish a very accurate value of the Solar Parallax.

The Heliometer has also been employed in some supplementary series on the parallaxes of the Northern brighter stars,

Digitized by Google

Mr. Hall having taken up Procyon and α Aquilae and myself Vega and α Leonis.

During the winter Mr. Hall completed the reductions of his work on the orbit of Titan, the results of which are in very satisfactory agreement with those of Bessel and Hermann Struve. The value found for the mass of Saturn is 1: 3500.5 of the Solar mass, Bessel's revised value being 1: 3502.5 and Struve's 1: 3498.

I myself spent the winter months in the West, observing the total solar Eclipse of Jan. 1, 1889, at Winnemucca, Nevada, under very favorable circumstances. I used the finder of the Heliometer for a general view of the Corona, and with the low power and large field of about 4° I could trace the equatorial streamers to a distance of about 100′ on either side from the limb. I devoted a part of the time near the beginning and end of totality to a careful scrutiny of a small portion of the outer rays of the corona with a view of detecting any possible rapid changes in the same, but during the 90 seconds of observation and in the portion I looked at, nothing of this nature occurred. I also had the good fortune to enjoy fine weather during a visit to the Lick Observatory, where by the courtesy of Prof. Holden and his staff, I had unlimited opportunities for forming a very high estimate of the powers of their magnificent 36 inch refractor, both for purely visual and for photographic purposes. In particular, I was enabled to do some measuring with the measuring engine of the Observatory, on some photographic plates of the Pleiades, most kindly taken especially for me with the large telescope. The comparison of the results with the star-places derived with the Heliometer at Yale afforded a most satisfactory proof of the accuracy of these latter, and of the immense possibilities of the photographic methods for micrometric work. I may add that in a paper sent to Dr. Gould for publication in the Astronomical Journal, where I have compared the results derived by him from Mr. Rutherfurd's Pleiades photographs with the Heliometer work, the extremely high accuracy attainable by photography is also very apparent.

Respectfully,

W. L. ELKIN,

Astronomer in charge of the Heliometer.

Digitized by Google

Digitized by Google

Digitized by Google

Educ T5603.5.5

Sci 772.5
4

REPORT FOR THE YEAR 1889–90, PRESENTED BY THE BOARD OF MANAGERS OF THE OBSERVATORY OF YALE UNIVERSITY TO THE PRESIDENT AND FELLOWS.

Digitized by Google

NOV 28 18

OBSERVATORY OF YALE UNIVERSITY.

BOARD OF MANAGERS.

Rev. TIMOTHY DWIGHT, D.D., LL.D., *President.*
EDWARD M. REED, M.A.
Professor HUBERT A. NEWTON, LL.D., *Secretary.*
WILLIAM W. FARNAM, M.A.
THOMAS G. BENNETT, PH.B.
Professor CHARLES S. HASTINGS, PH.D.

OFFICERS.

ROBERT BROWN, M.A., *Secretary.*
WILLIAM L. ELKIN, PH.D., *Astronomer in charge of the Heliometer.*

Digitized by Google

REPORT.

YALE UNIVERSITY, June 23, 1890.

To the President and Fellows of Yale University:

GENTLEMEN:—The Board of Managers herewith transmit the reports of Mr. Brown the secretary of the Observatory, and of Dr. Elkin, the Astronomer in charge of the Heliometer. The time service was in charge of Dr. Hall until he left us to accept a position in the Observatory at Washington. Since that time the clocks and the time signals have been under the care, first of Mr. John Whitmore, and later of Mr. B. W. McFarland.

Two members of the Board have died during the year, Professors Elias Loomis, and Chester S. Lyman. The Board desires to express its deep sense of the value of the services which these two men have rendered to the Observatory and to science, and of our loss by their removal from us. They were selected by Mr. Winchester to be Trustees of the institution at its first inception. He relied upon them for advice and assistance in giving wise direction to his generous designs for the advance of the Science of Astronomy. During eighteen years they have attended the meetings of the Trustees and of the Board, and by their counsel and labors have done what they could to build up the Observatory, and make it efficient. Professor Loomis moreover has shown his enduring interest in the Observatory by making it by will the recipient of his large fortune. After making liberal provision for his two sons he has given the remainder of his estate to form a *Loomis Fund* the income of which is to provide for the payment of the salaries of observers and computers in the Observatory, and for the expenses of publication of astronomical memoirs. The distinguished scientific work of his life will thus, we may trust, be continued through the future centuries of years.

Respectfully submitted by

THE BOARD OF MANAGERS.

Digitized by Google

SECRETARY'S REPORT.

YALE OBSERVATORY, June 18, 1890.

To the Board of Managers:

GENTLEMEN:—I have the honor to report that during the year ending June 1, 1890, the improvements of the Observatory grounds have progressed as follows:

1. The line of shade trees (elms) on our Highland street frontage has been completed.

2. Nineteen additional elms have been placed in the west sidewalk of St. Ronan street between Canner and Highland streets, leaving three required to complete that frontage when the grading is completed.

3. Considerable progress has been made in grading the west sidewalk of St. Ronan street, at which we are still at work. A large portion of the frontage on the east side, opposite our tract, has recently been sold, on which a handsome dwelling is now in process of construction, and others are contemplated, to be erected during the next year or the following.

4. Fence posts have been set on Highland, St. Ronan, and that part of Canner street where they were lacking, except near St. Ronan street, where further grading is first required. A few remain to be set on Prospect street, where hard rock requires blasting, and this shall be done as opportunity offers.

5. Within the Observatory lot, twenty-six young Norway spruces, contributed by Dr. Elkin, have been planted, here and there, with regard to future effect.

6. A few flowering and ornamental shrubs have been planted near the Observatory—all that could be done in this way with our small force, without delaying more important improvements.

At the death of Prof. Elias Loomis, by his will, the Observatory came into possession of a very fine portrait of himself by Mrs. H. A. Loop, painted in 1882, which will hang, for the present, in the office of the Observatory. As a gift from Mr. Henry B. Loomis and otherwise the Observatory possesses

Digitized by Google

valuable mementoes of Prof. Loomis:

The three thermometers long used by him:

B. Pike & Son, New York, Meteorological—with extra long bulb.

L. Casella, "verified" Maximum No. 2495.

L. Casella, "verified" Minimum No. 1791.

The writing desk at which his later work was done, and some of his book cases.

Before his death Professor Loomis had ordered that shelves be constructed at his expense for his books at the Observatory, which order had been partially complied with. Of his library bequeathed to the Observatory, after selections for the University Library, there has come to us the equivalent of 1900 volumes—estimating miscellaneous pamphlets, maps, etc., at the average thickness of books of the corresponding fold. Of the scientific serials many are complete; many lack a few volumes, and may be said to be nearly complete; and some, lacking more may be classed as incomplete, while the proportion in our possession of volumes issued is nevertheless quite considerable. It has not been practicable to make a full catalogue of this valuable bequest, but the following titles indicate, in a measure, its general character.

SERIALS.

American Journal of Science and Arts.

Transactions and Proceedings of the American Academy.

Transactions and Proceedings of the American Philosophical Society.

Memoirs and Monthly Notices of the Royal Astronomical Society.

Astronomische Nachrichten.

Philosophical Transactions of the Royal Society, London, 1801–56.

Transactions of the Cambridge Philosophical Society. Vols. I to XI.

Reports of the British Association for the Advancement of Science.

Greenwich Observations (incomplete).

American Journal of Mathematics.

Proceedings of the American Association for the Advancement of Science.

Mitchell's Sidereal Messenger.

Digitized by Google

Berliner Jahrbuch (incomplete).
Science.
Smithsonian Institution Reports.
Annals of Philosophy and Philosophical Magazine (incomplete).
Annales de l'Observatoire Physique Central de Russie—1854–64.
Wolf's Vierteljahrsschrift.
Reports of the U. S. Chief Signal Officer.
Reports of the U. S. Chief of Engineers.
Gould's Astronomical Journal.
Nature.
Nautical Almanac (Greenwich).
American Ephemeris and Nautical Almanac.
Philosophical Society, Glasgow (incomplete).
Dun Echt Observatory Publications.
Memoirs of the Connecticut Academy.
Leiden Observatory—Annalen.
Albany Institute—Transactions.
Meteorological Publications—Deutsche Seewarte, Hamburg.
St. Petersburg Observatory.
Oficina Meteorológica Argentina, Buenos Aires.
K. K. Central Anstalt, Vienna.
Government of India—Calcutta and Bombay.
British Government—Home and Colonial.
Carlo Alberto College, Moncalieri.
Norwegisches Meteorologisches Institut, Christiania.
Quarterly Journal of the Royal Meteorological Society, London.
Oesterreichische Gesellschaft, Zeitschrift. Vienna.
U. S. Weather Maps, bound and unbound.
U. S. International Weather Maps.
Symons's Meteorological Magazine.
Scottish Meteorological Society.
Tokio Daigaku.

BOOKS.

Bowditch LaPlace—Mécanique Céleste.
Pingré—Cométographie.
Montucla—Histoire des Mathématiques.
Sir J. Herschel—Cape Results.

Digitized by Google

Vega—Thesaurus Logarithmorum Completus.
British Association Catalogue.
Markree Catalogue.
Glasgow Catalogue.
Struve—Mensuræ Micrometricæ.
Halma-Ptolémée—Almageste.
Beer und Mädler. Der Mond.
LaLande—Bibliographie Astronomique.
Comte—Philosophie Positive.
Fourier—Théorie de la Chaleur.
Watson—Theoretical Astronomy.
Bayer—Uranometria.
Vince—Astronomy.
Pearson—Astronomy.
Gehler—Physikalisches Wörterbuch.
Bessel—Astronomische Untersuchungen.
Gauss—Theoria Motus.

The ordinary contributions to the Library, by donation and exchange, during the year, have been as follows:

Ann Arbor. American Meteorological Journal, Vol. VI, May, 1889–April, 1890. 8°. *Ann Arbor*, 1889–90. — Prof. H. A. Newton.

H. G. van de Sande Bakhuyzen. Beschreibung eines Apparats zur Bestimmung des absoluten persönlichen Fehlers bei Durchgangsbeobachtungen nebst Mittheilung der damit erhaltenen Resultate. 4°. *The Hague* [1889]. — The Author.

——et Bassot. Détermination de la Différence de Longitude entre Leyde et Paris. 4°. *Paris*, 1889. — H. G. van de Sande Bakhuyzen.

W. Beebe and A. W. Phillips. The Orbit of Swift's Comet 1880, V; determined by Gibbs' Vector Method [Astr. Jour., Nos. 207–8]. 4°. *Cambridge* [1889]. — The Authors.

Berkeley. Annual Report of the Secretary to the Board of Regents of the University of California, for the year ending June 30, 1889. 8°. *Sacramento*, 1889. — The University.

Digitized by Google

Smithsonian Institution. Frank H. Bigelow. The Solar Corona, discussed by Spherical Harmonics. 4°.
Washington, 1889.

The Academy. Bologna. R. Accademia delle Scienze dell' Instituto di——. Memorie, Serie IV, Tomo VIII. 4°. *Bologna*, 1888.

——— ——— ——— ———Tomo IX. 4°. *Bologna*, 1889.

——— ——— ———Note sur les derniers progrès de la question de l'heure universelle. 8°.
Bologna, 1888.

——— Boston. American Academy of Arts and Sciences. Proceedings. New Series. Vol. XV, Pt. II. 8°. *Boston*, 1888.

The Publishers. Buffalo. Medical and Surgical Journal. June, 1889–May, 1890. 8°. *Buffalo*, 1889–90.

The University. Cambridge, England. Thirty-fifth Annual Report of the Library Syndicate. 4°.
Cambridge, 1889.

The Observatory. ——Mass. Harvard College Observatory Annals. 4°.
Vol. XVII, No. IX. Meridian Circle Observations of Close Polar Stars. ——— ———

——— ——— ——— ———No. X. Meridian Circle Observations of Stars near the South Pole.
Cambridge, 1890.

——— ——— ——— ———Vol. XIX, Part I. Meteorological Observations 1840–88.
Cambridge, 1889.

——— ——— ——— ———Vol. XX, Part II. Observations at the Blue Hill Meteorological Observatory in 1888. *Cambridge*, 1889.

——— ——— ——— ———Vol. XXI, Part 1. Observations of the New England Meteorological Society in the year 1888. *Cambridge*, 1889.

——— ——— ——— ———Vol. XXII. Meteorological Observations made on the Summit of Pike's Peak, Colorado, January, 1874, to June, 1888, under the direction of the Chief Signal Officer, U. S. A. *Cambridge*, 1889.

——— ——— ———A Large Photographic Telescope. 4°.
Cambridge, 1888.

Digitized by Google

Cambridge, Mass. The Bruce Photographic Telescope. 4°. *Cambridge*, 1889.	The Observatory.
—— ——Henry Draper Memorial. Fourth Annual Report of the Photographic Study of Stellar Spectra. 4°. *Cambridge*, 1890.	——
—— ——Forty-fourth Annual Report of the Director. 8°. *Cambridge*, 1890.	——
—— ——Bulletin No. 62 of the New England Meteorological Society. 4°. *Cambridge*, 1889.	——
Chapel Hill. Journal of the Elisha Mitchell Scientific Society. Vol. VI, Parts 1 and 2. 8°. *Raleigh, N. C.*, 1889–90.	The Society.
Albert E. Church. Elements of Descriptive Geometry with its Application to Spherical Projections. 8°. *New York*, 1864.	Prof. F. E. Loomis.
Charles Davies. Treatise on Shades and Shadows and Linear Perspective. 8°. *New York*, 1859.	——
R. Dedekind. Vorlesungen über Zahlentheorie von P. G. Lejeune-Dirichlet. 8°. *Braunschweig*, 1863.	——
Denver. Publications of the Chamberlin Observatory of the University of Denver. No. 1. 8°. *Denver*, 1889.	The Observatory.
Charles L. Dodgson. Elementary Treatise on Determinants. 8°. *London*, 1867.	Prof. F. E. Loomis.
W. Döllen. Stern-Ephemeriden auf das Jahr 1890. 8°. *St. Petersburg*, 1890.	The Author.
Dublin. Scientific Transactions of the Royal Dublin Society. Vol. IV, (Series II,) III. Observations of the Planet Jupiter . . at Birr Castle Observatory, Parsonstown. By Otto Boedicker. 4°. *Dublin*, 1889.	The Society.
A. J. Dubois. Science and Miracle. 8°. *New Haven*, 1889.	The Author.
Dun Echt Observatory Circulars. Nos. 171–179 (and last). 8°. *Dun Echt*, 1889–90.	The Observatory.
Edinburgh. Royal Observatory Circulars. Nos. 1–6. 8°. *Edinburgh*, 1889–90.	——
Wm. L. Elkin. Comparison of Dr. Gould's Reductions of Mr. Rutherford's *Pleiades* Photographs with the Heliometer Results. [Astr. Jour., No. 197]. 4°. *Boston*, 1889.	The Author.

Digitized by Google

The Author. Folke Engström. Bestämning af Lunds Observatorii Polhöjd [Aftryck ur Lunds Univ. Årsskrift, Tom. XXV]. 4°. *Lund*, 1889.

Prof. F. E. Loomis. Carl Friedrich Gauss. Werke. Band 2, 3 und 4. 4°. *Göttingen*, 1863, '66 and '67.

The Observatory. Geneva. Rapport sur le Concours pour le réglage des Chronomètres pendant l'année 1888. Présenté à la Société des Arts, le 18 février 1889, par M. Em. Gautier. 8°. *Geneva*, 1889.

——— ——— ———1889. Présenté le 17 mars 1890. *Geneva*, 1890.

——— C. Gill. Mathematical Miscellany. 8°. *New York*, 1836.

——— Greenwich. Royal Observatory. Nautical Almanac and Astronomical Ephemeris for the year 1874. 8°. *London*, 1870.

——— ——— ——— ———for the year 1875. 8°. *London*, 1871.

The Lords Commissioners of the Admiralty. ——— ——— ———for the year 1893. 8°. *London*, 1889.

——— ———Royal Observatory. Astronomical and Magnetical and Meteorological Observations made in the year 1887, under the direction of W. H. M. Christie. 4°. *London*, 1889.

——— ——— ———Rates of Chronometers on Trial for purchase by the Board of Admiralty. 4°. *London*, 1889.

——— ——— ———Rates of Deck Watches on Trial for purchase by the Board of Admiralty. 4°. *London*, 1889.

——— ——— ———Assumed Mean Right Ascensions of Clock Stars with the corrections to the R. A. of the Nautical Almanac for 1890.0. 4°. *London*, 1889.

——— ——— ———Ten Year Catalogue of 4059 Stars for 1880. 4°. *London*, 1889.

——— ——— ———(a) Recomputation of the position of the Ecliptic from Observations of the Sun, in the years 1877–1886. (b) Corrections to Refraction of Stars, Sun, Moon, and Planets, for revised readings of the exterior thermometer and of the barometer, in the years 1877–1886. 4°. *London*, 1889.

Digitized by Google

Charles F. Hall. Narrative of the Second Arctic Expedition. 8°. *Washington*, 1879. — Prof. F. E. Loomis.

Havana. Observaciones Magnéticas y Meteorológicas del Real Colegio de Belen de la Compañia de Jesus. 4°. [To Dec., 1887.] *Havana*, 1889. — The College.

Haverford College Observatory. Micrometrical Measurements of Double Stars and other Observations, under the direction of F. P. Leavenworth. ——— [1889]. — The Observatory.

Helsingfors. Beobachtungen von Cometen angestellt auf der Sternwarte zu ——, im Winter und Frühjahr 1885–1886, von Anders Donner. [Abdruck aus Acta Soc. Sci. Fennicae, Tom. XVII.] 4°. *Helsingfors*, 1888. — ———

Karlsruhe. Veröffentlichungen der grossherzoglichen Sternwarte, herausgegeben von W. Valentiner. Drittes Heft. 4°. *Karlsruhe*, 1889. — ———

Kasan. Observations des Étoiles de la Zone entre 75° et 80° de déclinaison boréale. Sous la direction de Marian Kowalski. 4°. *Kasan*, 1887. — ———

S. P. Langley. The Temperature of the Moon. 4°. *Washington*, 1889. — The Author.

Liverpool Astronomical Society. Journal for Feb., 1889. Report of the Meteoric Section. *Liverpool*, 1889. — Prof. H. A. Newton.

Lund. Observations des Étoiles de la Zone entre 35° et 40° de déclinaison boréale—Réduites à l'équinoxe moyen de 1875.0 par N. C. Dunér et Folke Engström. Tome II, 1 et 2. 4°. *Lund*, 1889. — The Observatory.

Madrid. Memorias de la Real Academia de Ciencias Exactas, Físicas y Naturales. Tomo XIII, Partes 2 y 3. 8°. *Madrid*, 1888–89. — The Academy.

Manchester. Literary and Philosophical Society. Memoirs and Proceedings. Fourth Series. Vol. I. *Manchester*, 1888. — The Society.

——— ——— ———Fourth Series. Vol. II. *Manchester*, 1889. — ———

Digitized by Google

The Author. A. Marth. Ephemerides of the Satellites of Saturn, 1889–90. 8°. [Reprint from Mo. Not. R. A. S.] *London*, 1889.

—— —— —— ——(Concluded.) 8°. *London*, 1889.

—— —— ——Ephemeris of the Satellite of Neptune, 1889–90. 8°. *London*, 1889.

—— —— ——On the close Conjunction of Mars and Saturn, Sept. 19, 1889. On the Eclipse of Jupiter by Saturn and its Ring System, Nov. 1–2, 1889. 8°. *London*, 1889.

—— ——Ephemeris for Physical Observations of the Moon, 1889 (July 1) to 1890 (Jan. 1). 8°. *London*, 1889.

—— —— ——Ephemeris for Physical Observations of Jupiter, 1890. 8°. *London*, 1890.

The Observatory. Milan. Pubblicazioni del Reale Osservatorio di Brera. 4°. No. XXXV. Confronti e Verificazioni d'Azimut assoluti in Milano con alcune Notizie sulle Antiche Triangolazioni nei Dintorni di questa Città, di Michele Rajna. *Milan*, 1889.

Chas. S. Blackman. Montreal. Longitude of McGill College Observatory. By W. A. Rogers and C. H. McLeod. [Trans. Roy. Soc. Canada, IX, 1885.] 4°. *Montreal*, 1886.

The Author. Eliakim H. Moore. Algebraic Surfaces of which every Plane Section is unicursal in the light of N. Dimensional Geometry. 4°.

The Observatory. Mount Hamilton. Lick Observatory Publications. Vol. I. 4°. *Sacramento*, 1887.

The Author. H. A. Newton. Directions for observing Shooting Stars in July and August, 1889. 8°. [*New Haven*, 1889.]

The Publishers. New York. The Jewelers' Circular and Horological Review, June, 1889–May, 1890. Vol. XX, No. 5, to Vol. XXI, No. 4. 4°. *New York*, 1889–90.

The Association. New York. Mercantile Library Association. 68th Annual Report. 8°. *New York*, 1889.

Digitized by Google

Oxford. Radcliffe Observatory. Results of Astronomical and Meteorological Observations in the year 1885. Under Edward James Stone. Vol. XLIII. 8°. *Oxford*, 1889. — The Observatory.

Padua. Atti e Memorie della R. Accademia di Scienze, Lettere ed Arti. 8°. Anno CCLXXXIX (1887–88). Nuova Serie. Vol. IV. 8°. *Padua*, 1888. — The Academy.

—— ——Anno CCXC (1888–89). Nuova Serie. Vol. V. *Padua*, 1889. — The Academy.

Palermo. Pubblicazioni del Real Osservatorio. Anni 1884–1888. Vol. IV. 4°. *Palermo*, 1889. — The Observatory.

Paris. Connaissance des Temps — pour l'an 1891. 8°. *Paris*, 1889. — Bureau des Longitudes.

—— ——Extrait à l'usage des Écoles d'Hydrographie et des Marins du Commerce, pour l'an 1891. 8°. *Paris*, 1889. — ——

——Éphémérides des étoiles de Culmination lunaire et de longitude pour 1890, par M. M. Lœwy. 4°. *Paris*, 1889. — ——

——Annuaire de l'Observatoire Municipal de Montsouris, pour l'an 1889. 12°. *Paris*, 1889 — The Observatory.

——Le Galilée, Année 1889, Nos. 3–7. 8°. *Paris*, 1889. — The Publishers.

Edward C. Pickering. On the Spectrum of ζ *Ursae Majoris*. 8°. *New Haven*, 1890. — The Author.

Potsdam. Publicationen des Astrophysicalischen Observatoriums, herausgegeben vom Director H. C. Vogel. 6ter Band. 4°. *Potsdam*, 1889. — The Observatory.

Prague. K. K. Sternwarte. Magnetische und Meteorologische Beobachtungen im Jahre 1888. 49 Jahrgang. 4°. *Prague*, 1889. — ——

—— ——Astronomische Beobachtungen in den Jahren 1885, 1886 und 1887, enthaltend Originalzeichnungen des Mondes. L. Weinek. Appendix zum 46, 47 und 48 Jahrgang. 4°. *Prague*, 1890. — ——

Digitized by Google

The Society. Prague. Königl. böhmische Gesellschaft der Wissenschaften. Abhandlungen der Mathematisch-naturwissenschaftlichen Classe vom Jahre 1887–1888. VII. Folge, 2 Band. 4°. *Prague*, 1888.

——— ——— ———Jahresbericht, 1888. 8°. *Prague*, 1889.

——— ——— ———Sitzungsberichte der Mathematisch-naturwissenschaftlichen Classe. Jahrgang 1888. 8°. *Prague*, 1889.

——— ——— ——— ———Jahrgang 1889. I. 8°. *Prague*, 1889.

K. Böhm. Gesellsch. der Wissensch. ———Böhmischer Forstverein. Ombrometrische Beobachtungen. I. Jahrgang 1879. 4°. *Prague*, 1879.

——— ——— ——— ———II. Jahrgang 1880. 4°. *Prague*, 1880.

——— ——— ——— ———III. Jahrgang 1881. 4°. *Prague*, 1881.

——— ——— ——— ———IV. Jahrgang 1882. 4°. *Prague*, 1882.

The Observatory. Rugby. Report on the Temple Observatory for the year ending 1889. 8°. [*Rugby*, 1890.]

Prof. F. E. Loomis. George Salmon. A Treatise on the Analytic Geometry of Three Dimensions. 2d Edition. 8°. *Dublin*, 1865.

The Institute and Observatory. San Fernando. Almanaque Náutico para el año 1891. 8°. *Madrid*, 1889.

Dr. W. L. Elkin. San Francisco. Astronomical Society of the Pacific. Publications. Vol. I, No. 2. 8°. *San Francisco*, 1889.

The Society. ——— ———Vol. I, No. 3, to Vol. II, No. 7. 8°. *San Francisco*, 1889–90.

Prof. F. E. Loomis. J. A. Serret. Cours d'Algèbre Supérieure. 2^{me} Edition. 8°. *Paris*, 1854.

——— ———Traité de Trigonometrie. 4^{me} Edition. 8°. *Paris*, 1868.

——— ———Cours de Calcul Différentiel et Intégral. 2 Vols. 8°. *Paris*, 1868.

The Observatory. Tōkyō. L'Observatoire Astronomique. Annales. Tome I, 1er Fascicule. Détermination de la Latitude de l'Observatoire. 4°. *Tōkyō*, 1889.

Digitized by Google

Tōkyō. L'Observ. Astron. Annales. Tome I, 2me Fascicule. Observations of Comet E 1888. Elements of Comet E 1888. 4°. *Tōkyō*, 1889. — The Observatory.

Toronto. Report of the Canadian Observations of the Transit of Venus, 6th December, 1882. 8°. [*Toronto*, ——.] ——

——Meteorological Service of the Dominion of Canada. Report for the year ending December 31, 1886. *Ottawa*, 1889. — The Superintendent.

——Monthly Weather Review, April, 1889–March, 1890. 4°. *Toronto*, 1889–90. — The Director.

——The Canadian Institute. Proceedings. Vol. VII. Fasc. 1. 8°. *Toronto*, 1889. — The Institute.

—— ——Annual Report, Session 1888–9. 8°. *Toronto*, 1889. ——

University of Virginia. Publications of the Leander McCormick Observatory. Vol. I, Part 4. Double Stars 1885–86. 8°. *Univ. of Va.*, 1889. — The Observatory.

Utrecht. De Sterrenhemel, verklaard door F. Kaiser. Vierde Druk, bewerkt door J. A. C. Oudemans. Tweede Deel. 8°. *Deventer*, 1888. ——

Venice. Osservatorio Patriarcale. Annuario Astro-Meteorologico per l'anno 1889. Anno VII. 8°. *Venice*, 1888. — The Observatory.

Vienna. K. K. Universitäts-Sternwarte (Währing), Annalen. V. Band, Jahrgang 1885. 4°. *Vienna*, 1887. ——

—— —— ——VI. Band, Jahrgang 1886. *Vienna*, 1888. ——

——K. K. Gradmessungs-Bureau. Astronomische Arbeiten. I. Band. Längenbestimmungen. 4°. *Vienna*, 1889. — The Bureau.

——Kaiserliche Akademie der Wissenschaften. Circulars No. LXX. and LXXI. 8°. *Vienna*, 1889–90. — The Academy.

Washington. National Academy of Sciences. Memoirs. Vol. IV, Part 2. *Washington*, 1889. ——

Digitized by Google

Office of the Am. Eph. and Naut. Almanac. — Washington. American Ephemeris and Nautical Almanac for the year 1892. 8°. 2 Copies. *Washington*, 1889.

The Institution. — ——Smithsonian Institution. Photographs of the Corona taken during the Total Eclipse of the Sun, January 1, 1889. Structure of the Corona. By David P. Todd. 4°. *Washington*, 1889.

The Superintendent. — ——U. S. Coast and Geodetic Survey. Reports. 25 Vols. to complete our set. 4°. *Washington*, 1852–1888.

——— — ——Bulletins 1–17. 4°. *Washington*, 1888–9.

Dr. A. Hall, Jr. — ——Transit Observation Book. 8°.

The Observatory. — ——U. S. Naval Observatory. Catalogue of Stars observed during the years 1845 to 1877. M. Yarnall. Third edition. Revised by Edgar Frisby. 4°. *Washington*, 1889.

The Observatory. — Windsor, N. S. W. Report of Mr. Tebbutt's Observatory for the year 1888. 8°. *Sydney*, 1889.

——— — ——for the year 1889. *Sydney*, 1890.

Prof. F. E. Loomis. — J. Zech. Tafeln der Additions- und Subtractions-Logarithmen für Sieben Stellen. 8°. *Berlin*, 1863.

The Author. — Zurich. Astronomische Mittheilungen von Dr. Rudolph Wolf. 8°. Vol. V, Nos. XLI–L. *Zurich*, 1876–1879.

——— — ——Vol. VI, Nos. LI–LX. *Zurich*, 1880–1883.

——— — ——Vol. VII, Nos. LXI–LXX. *Zurich*, 1884–1887.

——— — ——Vol. VIII (current), Nos. LXXI–LXXV. *Zurich*, 1888, 1889.

Digitized by Google

THE THERMOMETRIC BUREAU.

The comparison of thermometers has continued to be made by Mr. C. B. Peck.

The number received for verification during the year ending June 1, 1890, was 8569, being 1094 in excess of the preceding, our previous maximum, year.

Very respectfully,

ROBERT BROWN,

Secretary of the Observatory.

REPORT OF DR. ELKIN.

YALE OBSERVATORY, June 10, 1890.

To the Board of Managers of the Observatory:

GENTLEMEN:—During the summer and autumn of 1889 the work with the Heliometer was principally directed to the observation of the minor planets, Victoria and Sappho, in connection with the observatories having a similar instrument at the Cape of Good Hope and at Leipzig, Göttingen and Bamberg, Germany. We secured complete series of measurements as follows:

on Victoria:	Elkin	37	Series.
	Hall	17	"
on Sappho:	Elkin	15	"
	Hall	18	"

The fewer number of observations of Victoria obtained by Dr. Hall is due to his having accepted an appointment at the Naval Observatory at Washington which required his presence there after the beginning of August. By the kind offices of Prof. Eastman, however, Dr. Hall was detailed to New Haven

Digitized by Google

for the Sappho work, so that during that period no favorable opportunity was allowed to escape. Before leaving, Dr. Hall saw through the press his paper on the Orbit of Titan and Mass of Saturn, published and distributed as Part I. of our Transactions.

The reductions of these measures of Victoria and Sappho have been kept well forward and require now only a final revision. For the Iris series in 1888 also, our own work—and that at Leipzig and Oxford—has been fully reduced and considerable progress made in the computations necessary for a deduction of the Solar parallax.

For the full utilization of all the measures made on Victoria, Dr. Gill has proposed a heliometric triangulation of the comparison stars. Mr. F. L. Chase has taken up the study of work with the heliometer and will carry out this measurement this summer.

Since the completion of the work on the minor planets I have taken up again the observations on the parallaxes of the first magnitude stars in the Northern hemisphere with the intention of carrying out the work as I had originally planned it, securing at least three independent results for each of the ten stars. It appeared to me that the advantages of the heliometer for these bright stars were such as to make it well worth while to pursue the investigation and strengthen the results already obtained, without the fear of their being immediately supplanted by those of the photographic method of observation. It seems difficult to resist the conviction that this latter method will prove incontestably superior for all but the very brightest stars. About one third of the proposed continuation has been secured.

The computations of the triangulation of the stars near the North Pole made in 1888, are in an advanced state though not yet quite completed.

Respectfully,

W. L. ELKIN,

Astronomer in charge of the Heliometer.

Digitized by Google

Digitized by Google

Digitized by Google

~~Stac R 5603.3.5~~

Sci 772.5
W

REPORT FOR THE YEAR 1890–91, PRESENTED BY THE BOARD OF MANAGERS OF THE OBSERVATORY OF YALE UNIVERSITY TO THE PRESIDENT AND FELLOWS.

Digitized by Google

HARVARD COLLEGE
JUL 6 1891
LIBRARY.

OBSERVATORY OF YALE UNIVERSITY.

BOARD OF MANAGERS.

Rev. TIMOTHY DWIGHT, D.D., LL.D., *President.*
EDWARD M. REED, M.A.
Professor HUBERT A. NEWTON, LL.D., *Secretary.*
WILLIAM W. FARNAM, M.A.
THOMAS G. BENNETT, PH.B.
Professor CHARLES S. HASTINGS, PH.D.

OFFICERS.

ROBERT BROWN, M.A., *Secretary.*
WILLIAM L. ELKIN, PH.D., *Astronomer in charge of the Heliometer.*
FREDERICK L. CHASE, B.A., *Assistant.*

Digitized by Google

REPORT.

YALE UNIVERSITY, June 22, 1891.

To the President and Fellows of Yale University:

GENTLEMEN:—The Board of Managers herewith transmit the reports of Mr. Brown the Secretary of the Observatory, and of Dr. Elkin, the Astronomer in charge of the Heliometer. The clocks and the time signals have been throughout the year under the care of Mr. B. W. McFarland.

Respectfully submitted by

THE BOARD OF MANAGERS.

Digitized by Google

SECRETARY'S REPORT.

YALE OBSERVATORY, June 17, 1891.

To the Board of Managers:

GENTLEMEN:—I have the honor to report the following improvements and repairs made to the buildings and grounds of the Observatory during the past year:

BUILDING.

The upper and lower halls and the south-east room on the first floor—the Reception Room and Office—and the bedroom above the latter have been tinted and papered for the first time. The bedroom has been carpeted and furnished for Mr. Chase's occupancy.

Absolutely necessary repairs have been made as follows:

1. The leaking roof of the main building has been patched.
2. All the tin roofs have been repainted.
3. The canvas-covered domes have been repaired and repainted.

OBSERVATORY RESERVATION GROUNDS.

A six-inch sewer connection, four hundred and twenty-five feet in length, has been laid from the southeast corner of the present main building, and along its south side, to a point about six feet east of the south gate-post of the southern branch of Dr. Elkin's driveway, where it connects with the branch sewer to Dr. Adams' house.

GROUNDS NORTH OF CANNER STREET.

The fifteen-inch drain pipe which was laid by the city under Canner street, when that street was graded, to receive the water which flows in the ravine through this lot from the northwest, we have extended one hundred feet up the ravine—laying the same carefully in cement. I recommend a further extension of four or five hundred feet, to be made whenever the prices of pipe and labor are most favorable.

Digitized by Google

The grading of the west sidewalk of St. Ronan street, which was under way at the date of the last report, has been prosecuted very nearly to completion. This street is seventy feet in width, of which eighteen feet on each side has been set apart for sidewalks and shade trees. The grade of the street is easy; from the center of Canner street, seventy-three feet above tidewater, rising, northward, four inches in one hundred feet for a distance of forty feet, thence eighteen inches in one hundred feet for a distance of five hundred feet, thence level for a distance of forty-five feet, thence descending eighteen inches in one hundred feet for a distance of five hundred and fifty-five feet to a point in Highland street. The middle point of our frontage (of about eleven hundred feet) is therefore about seven and a half feet above each end. The north end of our sidewalk required a fill of about two hundred and fifty feet long, and, at the deepest, eight or ten feet. But the land rises so rapidly from the street westwardly, that the excavation for a single cellar will probably fill the present depression to the grade of the sidewalk. In the next six hundred and fifty feet, southward, the surface rises rapidly to five or six feet above the established grade, falling again until at the southern end the last two hundred feet in length was from six to ten feet below the established grade. The sidewalk has been graded in such manner that across the fills the fence line has the regulation rise of nine inches above the curb line, but where the surface rises considerably the grade of the sidewalk, at the fence line, rises also to the height of thirty-six inches above the curb line. With the material thus excavated the fills at the two ends have been made, mainly; the top soil being reserved for the grass and for the trees. Of the eighteen feet in width, of the sidewalk, seven feet has been reserved for the walk, and the remaining eleven feet, rounded in section, has been put in grass, with a center line of twenty-six elm trees. For some of these trees the rock was blasted out eight or ten feet square and two and a half or three feet deep. There remains a gap of about sixty feet in length by about five feet in depth, to be filled at the south end, adjoining Canner street. The City Street Department having previously taken the surface of this street, which was above grade and easily removed, to another street or another portion of this street, has now or is about to undertake, as I am informed, the grading of the

Digitized by Google

street from curb to curb, involving a cut of about three feet in the middle third. When this has been done there will be immediately available for the market about eight hundred feet of frontage, about one-third of the way up the hillside and within five to eight hundred feet of the Whitney avenue line of street cars. In my judgment these lots should be laid out with a view to the preservation of a large proportion of the handsome forest trees which are scattered over four-fifths of the tract. And I think this end will best be attained by following Mr. Winchester's wisely expressed preference that the tract should be laid out in what is commonly called the "park style" in contradistinction from the strictly rectangular style which is found most convenient for city centers. In this manner the steep grades of the eastern slope may best be overcome, and some of the rougher features of the land, which it would be a great expense to remove, would contribute to the beauty of the whole, and the tract may be made to yield the largest sum to the designed endowment.

The contributions to the Library of the Observatory during the year ending June 1st, 1891, have been as follows:

Prof. H. A. Newton.	Ann Arbor. American Meteorological Journal, Vol. VII, May, 1890–April, 1891. 8°. *Ann Arbor*, 1890–91.
The Institute.	Berlin. Das Königlich Preussische Geodätische Institut. Aus Amtlichem Anlass. F. R. Helmert, Director. 8°. *Berlin*, 1890.
———	——— ———Astronomisch-Geodätische Arbeiten I Ordnung. Telegraphische Längenbestimmungen in den Jahren 1888 und 1889. 4°. *a.* Bestimmung der Polhöhe und des Azimutes auf der Schneekoppe im Jahre 1888. *b.* Bestimmung des Azimutes auf Station Trockenberg im Jahre 1889. *Berlin*, 1890.
The Academy.	Boston. American Academy of Arts and Sciences. Proceedings. New Series. Vol. XVI. 8°. *Boston*, 1889.
———	——— ——— ——— ———Vol. XVII. 8°. *Boston*, 1890.
———	——— ——— ——— ———Biographical Notices. [Extract from Vol. XVII.] *Boston*, 1890.

Digitized by Google

Buffalo. Medical and Surgical Journal. June, 1890–May, 1891. 8°. *Buffalo*, 1890–91. — The Publishers.

Cambridge. The Astronomical Observatory of Harvard College. Annals. 4°. — The Observatory.

Vol. XXI, Part II. Investigations of the New England Meteorological Society in the year 1889. *Cambridge*, 1890.

——— ——— ———Vol. XXIII, Part I. Discussion of Observations made with the Meridian Photometer during the years 1882–1888 by Edward C. Pickering and Oliver C. Wendell. *Cambridge*, 1890. ———

——— ——— ———Vol. XXIV. Results of Observations with the Meridian Photometer during the years 1882–1888. By Edward C. Pickering, Director, and Oliver C. Wendell. *Cambridge*, 1890. ———

——— ——— ———Vol. XXVII. The Draper Catalogue of Stellar Spectra Photographed with the 8-inch Bache Telescope as a part of the Henry Draper Memorial. *Cambridge*, 1890. ———

——— ——— ———Vol. XXX, Part I. Observations at the Blue Hill Meteorological Observatory in 1889. *Cambridge*, 1890. ———

——— ———Forty-fifth Annual Report of the Director. 8°. *Cambridge*, 1890. ———

——— ——— ———History during the Period 1840–1890. By Daniel W. Baker [Reprint from the Boston Evening Traveller]. 8°. *Cambridge*, 1890. ———

——— ———Variable Stars of Long Period. E. C. Pickering, Director. 4°. *Cambridge*, 1891. ———

Chapel Hill. Journal of the Elisha Mitchell Scientific Society. Vol. VII, 1890. 8°. *Raleigh, N. C.*, 1890–91. — The Society.

Christiania. Norwegische Commission der Europäischen Gradmessung. Geodätische Arbeiten. 4°. — The Commission.

Heft VI. Das Südliche Dreiecknetz zur Verbindung der Haupt-Dreieckseiten Toaas-Kolsas und Dragonkollen-Vagnarberg-Koster. *Christiania*, 1888.

Digitized by Google

The Observatory. Christiania. Heft VII. Die Trigonometrische Verbindung zwischen Christiania und Bergen. *Christiania*, 1890.

The Royal Norwegian Frederick Univ. ——Norwegisches Meteorologisches Institut. Jahrbuch für 1886. 4°. *Christiania*, 1887.

—— —— —— ——für 1887. 4°. *Christiania*, 1889.

The Observatory. Cincinnati. Publications of the Observatory, 11. Charts and Micrometrical Measures of Nebulæ, made in the years 1884, 1885 and 1886, by J. G. Porter. Director. 4°. *Cincinnati*, 1891.

—— Coimbra. Observações Meteorologicas feitas no Observatorio Meteorlogico e Magnetico da Universidade de Coimbra no Anno de 1889. 4°. *Coimbra*, 1890.

J. D. and E. S. Dana. Córdoba. Anales de la Oficina Meteorologica Argentina por su Director, Benjamin A. Gould. 4°.
Tomo I. Clima de Buenos Aires. *Buenos Aires*, 1878.

—— —— ——Tomo II. Climas de Bahia Blanca y Corrientes. *Buenos Aires*, 1881.

—— —— ——Tomo III. Climas de San Luis, *etc.* *Buenos Aires*, 1882.

—— —— ——Tomo IV. Climas del Rosario, *etc.* *Buenos Aires*, 1884.

—— —— ——Gualterio G. Davis, Director. Tomo V. Climas de Hernandarias, *etc.* *Buenos Aires*, 1887

—— —— ——Tomo VII. Climas de Villa Formosa (2 copies). *Buenos Aires*, 1889.

—— —— ——(Extracto del Tomo V.) Informes anuales y Documentos. *Buenos Aires*, 1885.

—— ——Resultados del Observatorio Nacional Argentino. Juan M. Thome, Director. 4°. Tomo VI. Observaciones del año 1875. *Buenos Aires*, 1886.

—— —— ——Tomo IX. Observaciones del año 1876. *Buenos Aires*, 1887.

—— —— ——Tomo X. Observaciones del año 1877. *Buenos Aires*, 1888.

Digitized by Google

Córdoba. Tomo XI. Observaciones del año 1878 (2 copies). *Buenos Aires*, 1889.	J. D. and E. S. Dana.
—— ——Tomo XII. Observationes del año 1879. *Buenos Aires*, 1890.	——
—— ——Tomo II. Benjamin A. Gould, Director. Observationes del año 1872. *Buenos Aires*, 1881.	——
—— ——Tomo XIV. —— Catálogo General. *Buenos Aires*, 1886.	——
W. Döllen. Stern-Ephemeriden auf das Jahr 1891. 8°. *St. Petersburg*, 1890.	The Author.
Dresden. Observatoire de B. D'Engelhardt. Observations Astronomiques. Part II. 4°. *Dresden*, 1890.	The Observatory.
N.-C. Dunér. Sur la Rotation du Soleil. [Öfversigt af Kongl. Vetenskaps-Akademiens Förhandlingar 1890. No. 2.] *Stockholm*, 1890.	The Author.
Durban, Natal, S. Africa. Annual Report of the Government Astronomer for the year 1889 [also of Government Laboratory]. E. Nevill, Supt. 4°. *Pietermaritzburg*, 1890.	The Observatory.
Edinburgh. Royal Observatory. Catalogue of the Crawford Library. 4°. *Edinburgh*, 1890.	——
——Royal Observatory Circulars. Nos. 7–15. 8°. *Edinburgh*, 1890–91.	——
——Royal Society. Transactions. Vol. XXXVI, Part I. (No. 6.) The Solar Spectrum at medium and low altitudes. Observations of the Region between Wave-lengths 6024 and 4861, Å.U. Ludwig Becker. 4°. *Edinburgh*, 1890.	The Astronomer Royal for Scotland.
Fleming, Sanford. Time Reckoning for the Twentieth Century. [Extract from the Smithsonian Report for 1886.] 8°. *Washington*, 1889.	The Canadian Institute.
Geneva. L'Observatoire de Genève. Règlement relatif au Dépôt et à la Comparaison des Chronomètres, du 21 Nov. 1890. 8°. *Geneva*, 1890.	The Observatory.

Digitized by Google

The Observatory — Geneva. Rapport sur le Concours pour le réglage des Chronomètres pendant l'année 1890. Présenté à la Société des Arts, le 21 Mars 1891, par M. Raoul Gautier. 8°.
Geneva, 1891.

The Astronomer Royal. — Greenwich. Royal Observatory. Astronomical and Magnetical and Meteorological Observations made in the year 1888, under the direction of W. H. M. Christie. 4°.
London, 1890.

——— ———Rates of Chronometers on Trial for purchase by the Board of Admiralty. 4°.
London, 1890.

——— ———Rates of Deck Watches on Trial for purchase by the Board of Admiralty. 4°.
London, 1890.

The Lords Commissioners of the Admiralty — ———Assumed Mean Right Ascensions of Clock Stars with the corrections to the R. A. of the Nautical Almanac for 1891.0. 4°.
London, 1890.

——— ———Nautical Almanac and Astronomical Ephemeris for the year 1894. 8°.
London, [1890].

The College. — Havana. Observaciones Magnéticas y Meteorológicas del Real Colegio de Belen de la Compañia de Jesus. 4°. [To Dec., 1888.]
Havana, 1890.

The University. ——Real Universidad de la Habana. Oracion Inaugural pronunciado en la Solemne Apertura del Curso Academico de 1890 á 1891 y Memoria-Annuario del de 1888 á 1889. 4°. *Havana*, 1890.

The Author. — Helsingfors. Formel und Tafeln zur Berechnung von Zeitbestimmungen durch Höhen in der Nähe des Ersten Vertikals. Anders Donner. 4°. *Helsingfors*, 1890.

Anders Donner. ——Tabeller för beräkning af barometriska höjdmätningar. Alfred Petrelius. 8°. [Extract from Fennia, III, No. 16.]
Helsingfors, 1890.

Digitized by Google

Keeler, James E. Mount Hamilton, Cal. Die Jupiteroberfläche im Jahre 1889. [Separat-Abdruck aus Himmel und Erde.] 8°. *Berlin*, 1890. — The Author.

—— ——On the Motions of the Planetary Nebulæ in the Line of Sight. [Extract from Publications of the Astronomical Society of the Pacific, Vol. II, No. 11.] 8°. *San Francisco*, 1890. ——

Kharkoff. Publication der Charkower Universitäts-Sternwarte, Heft No. 1. Ueber eine Polhöhenbestimmungsmethode von G. Lewitzky. 8°. *Kharkoff*, 1891. — The Observatory.

Kiel. Publication der Königlichen Sternwarte. IV. Anhang zu den Zonenbeobachtungen der Sterne zwischen 55° und 65° nördlicher Declination angestellt an den Sternwarten zu Helsingfors und Gotha.
No. 1. Revisionsbeobachtungen zum Zonencataloge.
No. 2. Berichtigungen zu den Originalzonen. 4°. *Kiel*, 1890. ——

—— ——V. Tafel für das dritte Glied der Praecession, von H. Kloock. 4°. *Kiel*, 1890. ——

—— ——VI. Untersuchungen über das System der Cometen 1843 I, 1880 I und 1882 II. II Theil. Der grosse Septembercomet 1882 II (Fortsetzung.) Von Heinrich Kreutz. *Kiel*, 1891. ——

S. P. Langley and F. W. Very. The cheapest Form of Light, from studies at the Allegheny Observatory. (Pyrophorus noctilucus.) [Extract from American Journal of Science, Vol. XI, Aug., 1890.] *New Haven*, 1890. — The Authors.

Leiden. Annalen der Sternwarte. 4°. V^ter Band. *The Hague*, 1890. — The Observatory.

—— ——VI^ter Band. *The Hague*, 1890. ——

Leipzig. Astronomische Gesellschaft. [Sonder-Abdruck aus V. J. S. der Astronomischen Gesellschaft.] Ephemeriden veränderlicher Sterne für 1891. E. Schoenfeld. 8°. *Leipzig*, 1890. — Dr. W. L. Elkin.

Digitized by Google

The Observer. John E. Lewis. Photographs—
a. Moon at First Quarter, July 5, 1889.
b. Orion.
c. His Reflector.
d. Moon, on glass, First Quarter, June 6, 1889. [*Ansonia, Conn.*, 1889.]

The University. Louvain. L'Université Catholique. Annuaire pour l'an 1891. 12°. *Louvain*, [1890].

The Society. Manchester. Literary and Philosophical Society. Memoirs and Proceedings. Fourth Series. 8°. Vol. III. *Manchester*, 1890.

—— —— —— ——Vol. IV, Nos. 1, 2 and 3. *Manchester*, 1891.

The Author. A. Marth. [Reprints from Mo. Not. R. A. S.] 8°. [Vol. L, No. 2.]
a. Ephemeris for Physical Observations of the Moon, 1890, January 1 to July 1.
b. Ephemeris of the Satellites of Uranus, 1890.
c. Ephemeris for Physical Observations of Mars, 1890.
d. Ephemeris of the Satellites of Mars, 1890. [Id., No. 3.] *London*, 1889.

—— ——Ephemeris for Physical Observations of the Moon, 1890, July 1 to December 31. [Id. No. 7.] *London*, 1890.

—— ——*a.* On the Computation of the Equation of the Centre in Elliptical Orbits of Moderate Eccentricities.
b. A Simple Solution of Kepler's Problem. [Id. No. 8.] *London*, 1890.

—— ——*a.* Two Auxiliary Tables for the Solution of Kepler's Problem.
b. Ephemerides of the Satellites of Saturn, 1890–91.

—— *c.* Ephemeris of the Satellite of Neptune 1890–91. [Id. No. 9.] *London*, 1890.

—— ——Ephemerides of the Satellites of Saturn 1890–91 (continued). [Vol. LI, No. 1.] *London*, 1890.

—— —— ——(concluded). [Id. No. 2.] *London*, 1890.

Digitized by Google

A. Marth. *a.* A List of Published Lunar Sketches and Photographs arranged according to the Sun's Position. — The Author.
b. Ephemeris for Physical Observations of the Moon, 1891, February 12 to May 5.
c. Ephemeris of the Satellites of Uranus, 1891. [Id. No. 3.] *London*, 1891.

Meudon. Observatoire d'Astronomie Physique de Paris. Compte Rendu d'une ascension scientiflque au Mont Blanc ; par M. J. Janssen. [Academie des Sciences, extrait des C. R. CXI.] 4°. *Paris*, 1890. — The Observatory.

Mexico. Sociedad Cientifica "Antonio Alzate." Tomo III. Cuadernos núms. 1–8. 8°. *Mexico*, 1889–90. — The Society.

Milan. Pubblicazioni del Reale Osservatorio di Brera. 4°. No. XXXVI. Determinazione della differenza di Longitudine tra gli Osservatorii Astronomici di Milano e di Torino, mediante osservazioni fatte nel 1885 da Michele Rajna e Francesco Porro. Calcolate e discusse da Francesco Porro. *Milan*, 1890. — The Observatory.

—— ——No. XXXVII. Andamento Annuale e Diurno delle Precipitazioni nel clima di Milano. per E. Pini. 4°. *Milan*, 1890. ——

Montsouris. Observatoire Municipal. Annuaire pour l'an 1890. 12°. *Paris*, 1890. ——

Moscow. Annales de l'Observatoire. 2me Série. Vol. II, livraisons 1 et 2. Th. Bredichin. 4°. *Moscow*, 1890. ——

H. A. Newton. Elias Loomis, LL.D., 1811–1889. Memorial Address delivered at Osborn Hall, April 11, 1890. 8°. *New Haven*, 1890. — The Author.

—— —— ——Another copy. *New Haven*, 1890. — Henry B. Loomis.

New York. The Jewelers' Circular and Horological Review. 4°. June, 1890–January, 1891. Nos. 5 to 12, completing Vol. XXI. *New York*, 1890–91. — The Publishers.

—— ——Vol. XXII, Nos. 1–17. (Weekly.) *New York*, 1891. ——

Digitized by Google

The Observatory. Nice. Fondation R. Bischoffsheim. Annales de l'Observatoire. M. Perrotin, Directeur. Tome III. Texte 4°. *Paris*, 1890.

——— ——— ———Atlas, Long fol. *Paris*, 1890.

——— Northfield. Carleton College Observatory, Wm. W. Payne, Director. Publications. 1. Catalogue of 644 Comparison Stars, Herbert C. Wilson. 4°. *Northfield*, 1890.

——— Oxford. Radcliffe Observatory. Results of Astronomical and Meteorological Observations in the year 1886. Under Edward James Stone. Vol. XLIV. 8°. *Oxford*, 1890.

The Academy. Padua. Atti e Memorie della R. Accademia di Scienze, Lettere ed Arti. 8°. Anno CCXCI (1889–90). Vol. VI. 8°. *Padua*, 1890.

Bureau des Longitudes. Paris. Académie des Sciences. Étude du Système Optique formé d'une Lunette Astronomique et d'un double Miroir. Méthode la plus précise pour la mesure des distances en vue de l'Étude de l'Abberration et de la Réfraction. Par M. Loewy et P. Puiseux. 4°. *Paris*, 1890.

——— ———Annales du Bureau des Longitudes. Travaux faits à l'Observatoire Astronomique de Montsouris (section navale) et mémoires divers. Tome IV^me^. 4°. *Paris*, 1890.

——— ———Annuaire pour l'an 1890. 12°. *Paris*, [1889].

——— ———Connaissance des Temps. Pour l'an 1892. 8°. *Paris*, 1890.

——— ———Enquêtes et Documents rélatifs à l'Enseignement Supérieur. XXXII. Rapport sur les Observatoires Astronomiques de Province M. Loewy. 8°. *Paris*, 1889.

——— ——— ———XXXVIII. *Paris*, 1890.

The Society. Prague. Königl. böhmische Gesellschaft der Wissenschaften. Abhandlungen der mathematisch-naturwissenschaftlichen Classe vom Jahre 1889–1890. VII. Folge, 3 Band. 4°. *Prague*, 1890.

Digitized by Google

Prague. Königl. böhmische Gesellschaft der Wissenschaften. Jahresbericht, 1889. 8°. *Prague*, 1890. — The Society.

—— —— ——, 1890. 8°. *Prague*, 1891. ——

—— ——Sitzungsberichte der Mathematisch-naturwissenschaftlichen Classe. Jahrgang 1889. II. 8°. *Prague*, 1890. ——

—— —— ——Jahrgang 1890. I. 8°. *Prague*, 1890. ——

—— —— ——1890. II. 8°. *Prague*, 1891. ——

——K. K. Sternwarte. Magnetische und Meteorologische Beobachtungen im Jahre 1889. 50 Jahrgang. 4°. *Prague*, 1890. — The Observatory

Pulcova. De la Rotation de la Terre sous l'influence des Actions Géologiques. Mémoire présenté à l'Observatoire de Poulkova à l'occasion de sa Fête Semiséculaire par I. V. Schiaparelli. 8°. *St. Petersburg*, 1889. — The Observatory.

——Nicolai-Hauptsternwarte. Sammlung der Beobachtungen von Sternbedeckungen während der totalen Mondfinsterniss, 1888 Januar 28. Herausgegeben von Otto Struve. 8°. *St. Petersburg*, 1889. ——

—— ——Zum Fünfzig-Jährigen Bestehn der Nicolai-Hauptsternwarte. Beschreibung des 30-Zölligen Refractors und des Astrophysikalischen Laboratoriums. 4°. *St. Petersburg*, 1889. ——

——Observations de Poulkova. Publiées par Otto Struve, Directeur de l'Observatoire Central Nicolas. Vol. VIII. Catalogues d'Étoiles déduits des Observations publiées dans les Volumes VI et VII. 4°. *St. Petersburg*, 1889. ——

—— ——Supplement II. Photometrische Bestimmung der Grössenclassen der Bonner Durchmusterung. Ed. Lindemann. 4°. *St. Petersburg*, 1889. ——

——Tabulae Quantitatum Besselianarum pro Annis 1890 ad 1894 computatae. Edidit Otto Struve. (Contin.-tabularum annis 1861, 1867, 1871, 1879 et 1885 editarum). 8°. *St. Petersburg*, 1889. ——

Digitized by Google

The Observatory. Rome. Specola Vaticana. Regolamento della Specola Vaticana. 8°. *Rome*, 1890.

——— Rugby. Report on the Temple Observatory for the year ending 1890. 8°. [*Rugby*, 1891.]

The Academy. St. Louis. Academy of Science. Founders, Charter, Constitution, etc., Members and Exchanges. 8°. *St. Louis*, 1890.

The Observatory. ——— ———The Total Eclipse of the Sun, January 1, 1889. A Report of the Observations made by the Washington University Eclipse Party, at Norman, California. 4°. *Cambridge* [*Mass.*], 1891.

The Institute and Observatory. San Fernando. Instituto y Observatorio de Marina. Almanaque Náutico para el año 1892. 8°. *Madrid*, 1890.

——— ——— ———Catálogo de la Biblioteca. 8°. *San Fernando*, 1889.

The Society. San Francisco. Astronomical Society of the Pacific. Publications. Vol. II, No. 8, to Vol. III, No. 15. *San Francisco*, 1890–91.

The Author. Robert Schram. Actual State of the Standard Time Question. [Extract from The Observatory, No. 161, April, 1890.] 8°. [*London*, 1890.]

——— ———Stundenzonen-System der Amerikanischen Eisenbahnen. [Separat-Abdruck aus Nr. 6 der Monatsblätter des Wissensch. Club, in Wien, vom 15 März 1890.] 8°. *Vienna*, 1890.

——— ———Adria Zeit. [Separat-Abdruck aus der Neuen Freien Presse.] 16mo. *Vienna*, 1889.

——— ———Ausländische Stimmen über die Adria Zeit. [Separat-Abdruck aus der Wiener Zeitung, No. 169.] 16mo. *Vienna*, [1890].

——— ———La Zona Oraria dell' Adriatico. 32mo. *Triest*, 1890.

The University. South Bethlehem. Lehigh University. Register for 1890–91. 12mo. *S. Bethlehem*, 1890.

The Observatory. Sydney. Results of Rain, River, and Evaporation Observations made in New South Wales during 1889. H. C. Russell, Government Astronomer. 8°. *Sydney*, 1890.

Digitized by Google

Sydney. Results of Meteorological Observations made in New South Wales during 1888. H. C. Russell, Government Astronomer. 8°. *Sydney*, 1890.	The Observatory.
Tacubaya. Observatorio Astronómico Nacional. Boletin Tomo I. Núm. 1–3. 4°. *Mexico*, 1890.	——
Tananarive. Observatoire Royal de Madagascar. Résumé des Observations Météorologiques. Par le R. P. E. Colin, S. J. 1889. 8°. *Tananarive*, 1890.	Dr. W. L. Elkin.
Tōkyō. Imperial University of Japan. (Teikoku Daigaku.) Calendar for the year 1889–90. 8°. *Tōkyō*, 1889.	The University.
Toronto. Meteorological Service of the Dominion of Canada. Report for the year ending December 31, 1887. 8°. *Ottawa*, 1890.	The Superintendent.
——Monthly Weather Review, April, 1890–February, 1891. 4°. *Toronto*, 1890–91.	The Director.
——General Meteorological Register for the year 1890. 8°. *Toronto*, [1891].	——
——The Canadian Institute. Proceedings. Vol. VII, fasciculus 2. 8°. *Toronto*, 1890.	The Institute.
——Transactions. 1889–90. Vol. I (Nos. 1 and 2). 8°. *Toronto*, 1890–91.	——
——Fourth Annual Report, Session of 1890–91. 8°. *Toronto*, 1891.	——
[Traxler, R. P., copyrighted by.] The Principles of Mechanics as applied to the Solar System, etc., etc. 8°. *San Francisco*, 1889.	The Author.
Turin. Osservatorio della R. Università di Torino. Osservazioni Meteorologiche fatte nell' anno 1889, calcolate dalle Dottore G. B. Rizzo. 8°. *Turin*, 1890.	The Observatory.
——Effemeridi del Sole e della Luna per l'orrizonte di Torino e per l'anno 1891, calcolate dall' Ing. Tomaso Aschieri. 8°. *Turin*, 1890.	——
——Sulla Stella variabile U Orionis (Chandler 2100). Nota di Francesco Porro. 8°. *Turin*, 1890.	——

Digitized by Google

The Observatory. Turin. Sulle Determinazioni di Latitudine eseguite negli anni 1888, 1889, 1890 all' Osservatorio di Torino. Communicazione preliminare di Francesco Porro. 8°.
Turin, 1890.

—— University of Virginia. Publications of the Leander McCormick Observatory. Vol. I, Part 5. Durchmusterung, −23°. 8°.
Charlottesville, 1890.

—— Vienna. K. K. Universitäts-Sternwarte (Währing), Annalen. I. Supplement Band. Katalog der Argelander'schen Zonen vom 15 bis 31 Grade Südlicher Declination für 1850.0. Dr. Edmund Weiss, Director. 8°.
Vienna, 1890.

The Bureau. ——K. K. Gradmessungs-Bureau. Astronomische Arbeiten. II Band. Längenbestimmungen. 4°. *Vienna*, 1890.

The Academy. ——Kaiserliche Akademie der Wissenschaften. Circular No. LXXII. 8°. *Vienna*, 1890.

The Observatory. Vilafranca del Panadés. Estación Meteológica. Observaciones efectuadas durante el año 1890. José Baltá R. de Cela. 8°.
Vilafranca, 1891.

Office of the Am. Eph. and Naut. Almanac. Washington. American Ephemeris and Nautical Almanac for the year 1893. 8°. 2 Copies.
Washington, 1890.

Branch Hydrog. Office, New York. ——Hydrographic Office, U. S. Navy. Folio.
Washington, 1890–91.
a. Pilot Charts of the North Atlantic Ocean. November, 1890–March, 1891.
b. Bulletin No. 62 and 3 Supplemental Charts.

U. S. Coast and Geod. Survey. ——U. S. Coast and Geodetic Survey. Report of the Superintendent for the year ending with June, 1888. 4°. *Washington*, 1889.

—— —— ——Bulletins, Nos. 18–21. 4°
Washington, 1890–91.

—— —— ——Charts. Folio. *Washington*, 1890.

Digitized by Google

Washington. U. S. Coast and Geodetic Survey. U. S. Coast and Geod. Survey.
a. Isogonic Chart of the United States for the Epoch 1890.
b. Alaska and Adjacent Regions.
c. Magnetic Meridians of the United States for January, 1890.
d. Annual Change of the Magnetic Declination for the Epoch January, 1890.

Washington. U. S. Board on Geographic Names. The Board.
Bulletins No. 1 and 2. 8°.
Washington, 1890–91.

——U. S. Naval Observatory. Observations made during the year 1884. 4°. The Observatory.
Washington, 1889.

—— —— ——1885. 4°. *Washington*, 1891. ——

—— —— —— ——Appendix I. The International Astrophotographic Congress, and a visit to certain European Observatories and other Institutions. Report to the Superintendent by Albert G. Winterhalter. 4°.
Washington, 1889.

—— —— —— ——Appendix II. Saturn and its Ring, 1875–1889. Asaph Hall. 4°. ——
Washington, 1889.

—— —— —— ——Appendix III. The Solar Parallax and its Related Constants, including the Figure and Density of the Earth. Wm. Harkness. 4°. *Washington*, 1891. ——

—— ——Observations 1886. Appendix I. Magnetic Observations, 1888 and 1889, by Ensign J. A. Hoogewerff, U. S. Navy. 4°. ——
Washington, 1890.

—— ——Report of the Superintendent for the year ending June 30, 1889. 8°. ——
Washington, 1889.

—— —— ——for the year ending June 30, 1890. 8°. *Washington*, 1890. ——

Zurich. Astronomische Mittheilungen von Dr. Rudolph Wolf. 8°. Vol. VIII, Nos. LXXVI and LXXVII. *Zurich*, 1890–91. The Author.

Digitized by Google

In addition to the foregoing there have been placed upon the Library table, shortly after publication, as loans, the following periodicals :—

By Professor Newton : "The Observatory"—for the past three years.

By Dr. Elkin : "Astronomische Nachrichten." "The Astronomical Journal." "Vierteljahrsschrift der Astronomischen Gesellschaft." "Science."

By others : "Nature." "American Journal of Science and Arts."

In the absence of any fund whatever for the increase of the Library, either by the purchase of books or by subscription to the absolutely necessary current literature, the great acceptability of these temporary provisions will be recognized at once. Through the Loomis bequest, the Library possesses complete or nearly complete sets of these periodicals down to within two or three years. The continuations loaned, as above, belong to series reaching far back, and to break these would in some cases be a damage out of proportion to the gain of the Observatory. Situated as we are a mile and a half from the College Library, such of these periodicals as are to be found there can be of little use to us, in the frequent momentary references which have to be made in the progress of our work. The income of an initial fund of about one thousand dollars, for the maintenance of subscriptions to the most essential astronomical periodical literature seems to be a desideratum requiring only to be known to be attained. It will be observed that our publications bring us a large number of exchanges, including some which are not exclusively Astronomical but which are very acceptable, and these exchanges are continually increasing. But there are many necessary publications which are not freely exchanged, and for these a further endowment fund is greatly needed, but can await the provision of that first named.

THERMOMETRIC BUREAU.

Mr. Peck has continued to make the thermometer comparisons. The principal American manufacturers maintain their standard for small corrections. Perhaps a quality of the "Independent Index" form—not, however, essential—ought to be noticed in these reports : it is that of losing, more or

Digitized by Google

less easily the sustaining power of the "trap." We have often to reject instruments—not unfrequently to the extent of twenty per cent.—in which, *occasionally*, the index will drop, the greatest care being exercised, while in a larger number of instances, and at the same temperature, it will maintain its position as a maximum register. This quality has probably been generally recognized by makers and users, and not regarded as more serious than the permanent loss of the "short" index, which could, indeed, be restored, but with a liability to change in the corrections. Under unequal stress in the glass, from the mode of cooling after the production of the "trap," probably, a slight concussion will sometimes cause a minute fracture in the "trap" by which its sustaining power is lost. Recently three instruments were returned to us, which would not under any circumstances register: but two months previously, under repeated tests they did not fail to register; in one of them the microscope revealed a small loosened fragment of glass, just below the "trap," which must either have been detached after our previous examination, or, by its position, have assisted the trap at that time in the performance of its function; the other two instruments are assumed to have undergone a like fracture, although that was not demonstrated.

Mr. Peck also calls attention to the observation that some instruments of this form which register correctly when suddenly transferred to a temperature lower by ten degrees or more, will fail to register when the temperature is more gradually lowered, as by transfer to a medium only ten, or less, degrees cooler—or when left in a bath which is allowed to slowly fall in temperature. The cause of this is taken to be that in a particular construction of the "trap" a somewhat sudden contraction of the mercury near the "trap" may be required to overcome a cohesion of the mercury which is more effective than the resistance of the "trap." In many of these cases the preservation of the instrument in a horizontal position, where that is practicable, until the reading is made, will probably overcome the difficulty, exercising care that the index does not rise as in some cases it will, even against gravity.

Very respectfully,

ROBERT BROWN,

Secretary of the Observatory.

Digitized by Google

REPORT OF DR. ELKIN.

YALE UNIVERSITY, June 9, 1891.

To the Board of Managers of the Observatory:

GENTLEMEN:—The work under my charge has progressed during the past year as follows:

In observational work with the Heliometer I have been engaged almost wholly in the continuation of the series on the parallaxes of the first magnitude stars in the Northern hemisphere. The scheme originally laid out has now been completed and furnishes for each of the ten stars three (for Arcturus, five) independent results. The reductions are also nearly finished and the final values will be very shortly ready for publication.

The triangulation of the comparison stars for Victoria according to the plan drawn up by Dr. Gill has been carried out by Mr. F. L. Chase, who secured some 450 measures of these stars during the months of June to October, 1890. Mr. Chase has also reduced the observations as far as it was advisable for us to do so here and the results have been communicated to Dr. Gill, along with the reduced results of our observations of Victoria and Sappho in 1889. Since February, 1891, Mr. Chase has been engaged in a triangulation of the principal stars in *Coma Berenices* and up to date about one-half of the proposed measures have been obtained. Mr. Chase has also used the 8-inch Reed Equatorial for the determination of places of Comet Zona (1890, iv) and several asteroids, the results of which have been published in the *Astronomical Journal.*

The computations on the Iris series in 1888 have been carried forward to an advanced stage, a large part of the work being done by Miss Margaretta Palmer. The heliometer observations have been reduced and compared with a provisional ephemeris and preliminary places of the comparison stars, the resulting equations of condition formed and a first solution of the same carried out. For the final solution a careful discussion of the errors of the ephemeris and the definitive places of the stars are required; these latter are to

Digitized by Google

be furnished by Prof. Auwers from the whole mass of meridian observations made in 1888 and 1889. The reduction of the polar triangulation is also nearly finished and requires only a final revision.

It is proposed during the ensuing season to devote the Heliometer to a series of measures on the satellites of Jupiter for the determination of their orbits and the mass of the planet, comparing them *inter se*, as has been done with such success by Herrmann Struve at Pulkova with those of Saturn. For this purpose it seems to me that in one important respect the heliometric method is not likely to be surpassed by other methods, and that is in the accuracy with which the scale-value and the orientation can be ascertained.

Respectfully,

W. L. ELKIN,

Astronomer in charge of the Heliometer.

Digitized by Google

Digitized by Google

Educ R 1603.3.5

Sci 7721.5

REPORT FOR THE YEAR 1891–92, PRESENTED BY THE BOARD OF MANAGERS OF THE OBSERVATORY OF YALE UNIVERSITY TO THE PRESIDENT AND FELLOWS.

Digitized by Google

HARVARD COLLEGE
JUL 5 1892
LIBRARY.

OBSERVATORY OF YALE UNIVERSITY.

BOARD OF MANAGERS.

Rev. TIMOTHY DWIGHT, D.D., LL.D., *President.*
Professor HUBERT A. NEWTON, LL.D., *Secretary.*
WILLIAM W. FARNAM, M.A.
THOMAS G. BENNETT, PH.B.
Professor CHARLES S. HASTINGS, PH.D.

OFFICERS.

ROBERT BROWN, M.A., *Secretary.*
WILLIAM L ELKIN, PH.D., *Astronomer in charge of the Heliometer.*
FREDERICK L. CHASE, B.A., *Assistant.*

Digitized by Google

REPORT.

YALE UNIVERSITY, June 22, 1895.

To the President and Fellows of Yale University:

GENTLEMEN:—The Board of Managers herewith transmit the reports of Mr. Brown, the Secretary of the Observatory, and of Dr. Elkin, the Astronomer in charge of the Heliometer.

Respectfully submitted by

THE BOARD OF MANAGERS.

Digitized by Google

SECRETARY'S REPORT.

YALE UNIVERSITY OBSERVATORY,
NEW HAVEN, CONN., June 21, 1895.

To the Board of Managers:

GENTLEMEN:—I have the honor to report for the year ending with May 31, 1894, as follows:

THE OBSERVATORY BUILDING.

The wood-work of this building—principally the Transit Room and the frame room serving as an approach to the East Tower—not having been painted since 1882, has this Spring been given a good coat of paint, with the intention of soon giving it a second coat, as little was left of the original paint. Some sort of vestibule is needed for the entrance to the building. The present door is a very light one, probably intended for an interior door. It has shrunken and the sill has worn away so that much water is driven in during an easterly rain storm, and wind during cold weather, so that with waste of fuel, the building is at times too cold for sedentary work. With a light portable vestibule covering the top of the present platform, in winter, the present door could be mended to suffice perhaps better than by replacing the door—a double one—by a heavier.

THE OBSERVATORY GROUNDS.

A cemented 4-inch Akron tile drain has been laid from the roof-water-conductor in the middle of the north side of the main building, to connect with the sewer drain west of the West Tower. This new drain has been laid at such depth that it can be extended with a sufficient incline to receive the water from the north side of the proposed extension between the present main building and the East Tower, whenever that shall be made, or from the present East Tower whenever that may seem desirable. The water-conductors from the north side of the Transit Room have also been connected with the drain. At the same time, on account of an obstruction in the plumbing which caused continued or repeated overflows from the sinks in the Thermometer Testing Room, a connection was made with this drain through the north wall of the cellar

Digitized by Google

beneath, and through a hydraulic trap on the outside of the building, and in such a manner that inspection can readily be made and any future obstruction located and removed, without severing any pipes.

Heretofore the rain-water from the roof of the Transit Room has run under the room and *may* prove, when a similar connection on the south side has been provided for the prompt removal of the other half of the water, to have been the cause —or the partial cause—of a slight variation in the Transit piers, not otherwise accounted for.

The water heretofore shed from the roof of the main building has repeatedly washed out the sod and cut up the driveway, so that this betterment will be justified by the reduction of expense upon, and improved condition of, the driveway and the turf.

On the north side of the north driveway and west of the center line through the building, a small amount of regrading has been done.

Mention was omitted in the last Annual Report that in November, 1893, the boundary line between the Observatory Reservation and the land on the east and south, belonging to the estate of Massena Clark, deceased, was re-surveyed with this result: the point in the north line of the Winchester estate where the dividing line takes its origin was found substantially correct, but at the north end this line was found to be about seven feet east of the old fence: and the line thence to St. Ronan st. was found to be about two feet south of the old fence—substantially agreeing with my former rough measures. On this re-surveyed line Mr. Clarke's estate erected a temporary, but at present sufficient fence, the respective parties in interest paying each his proportional share of the cost.

ST. RONAN ST. LOT.

Tall cedar fence posts have been set on the east line of the lot on St. Ronan st., south from Canner st., with wire fencing, which can be moved up on the posts as the street and sidewalk are filled.

GROUNDS NORTH OF CANNER STREET.

The further extension of the 15-inch drain awaits instructions as to lines and grades.

*

Digitized by Google

The contributions to the Library of the Observatory during the year ending with May 31, 1895, have been as follows :

The Observatory. Armagh. The Observatory. Micrometric Observations of Nebulae. By J. E. L. Dreyer. [Extract from Trans. Roy. Irish Acad., Vol. XXX, Pt. XIII.] 4°. *Dublin*, 1894.

—— Bamberg. Die Sternwarte. Ueber die Untersuchung der Scalen eines Heliometers, II. [Abdruck aus den Astr. Nach. Bd. 135.] Dr. Gerhard Lorentzen. 4°. *Kiel*, 1894.

—— —— ——Die Zeitmessungseinrichtungen der Sternwarte zu Bamberg. E. Hartwig. 8°. *Leipzig*, 1893.

—— Berlin. Die Königliche Sternwarte. Astronomische Beobachtungen. Zweite Serie. Band I, 1ter und 2ter Theil. Zonenbeobachtungen der Sterne zwischen 20 und 25 Grad nördlicher Declination. 4°. *Berlin*, 1892, 1893.

The Academy. Bologna. R. Accademia delle Scienze dell' Istituto. Memorie della Sezione delle Scienze Fisiche e Matematiche. Serie V, Tomo III. 4°. *Bologna*, 1893.

—— Boston. American Academy of Arts and Sciences. Proceedings. New Series. Vol. XXI. 8°. *Boston*, 1894.

The Institute. Bucharest. Institutul Meteorologic. Buletinul Observatiunilor-Meteorologice din România. Steffan C. Hepites, Directorul. 4°. Anul. III, 1894 [May to Dec. incl.] *Bucharest*, 1894.

—— —— ——Analele. Tom. VII, 1891. 4°. *Bucharest*, 1893.

—— —— —— ——Tom. VIII, 1892. 4°. *Bucharest*, 1894.

The Publishers. Buffalo. Medical and Surgical Journal. July, 1894–May, 1895. 8°. *Buffalo*, 1894–95.

Professor H. A. Newton. Callandreau, M. O. Étude sur la Théorie des Comètes Périodiques. [Extrait des Annales de l' Observatoire de Paris, Mémoires t. XX.] 4°. [*Paris*, ——.]

Digitized by Google

Cambridge. The Astronomical Observatory of Harvard College. Annals. 4°. Vol. XXXII. Part I. Investigations in Astronomical Photography. By Wm. H. Pickering. *Cambridge*, 1895. — The Observatory.

—— —— ——Vol. XXXV. Journal of the Zone Observations of Stars between 49° 50′ and 50° 10′ of North Declination in 1855.0. By Wm. A. Rogers. *Waterville, Me.*, 1894. ——

—— —— ——Vol. XL, Part III. Observations made at the Blue Hill Meteorological Observatory, in the year 1893. *Cambridge*, 1894. ——

—— —— ——Vol. XLI, Nos. I and II. Observations of the New England Weather Service in the years 1892 and 1893. [*Cambridge*, 1894.] ——

——Forty-ninth Annual Report of the Director. 8°. *Cambridge*, 1894. ——

Cambridge, (England.) The Observatory. Astronomical Observations. 4°. Vols. VII to XXII, (1834–1869.) *Cambridge*, 1835–1890. ——

Capetown. Royal Observatory. Report of H. M. Astronomer at the Cape of Good Hope to the Secretary of the Admiralty, for the period 1879, May 26, to 1889, July 21. 4°. [*London*, 1893.] ——

—— ——for the period 1889–92. 4°. *London*, 1893. ——

—— ——for the year 1893. 4°. *London*, 1894. ——

——Heliometer Observations for determination of Stellar Parallax. 1881–1883. 8°. *London*, 1893. ——

Chapel Hill. Journal of the Elisha Mitchell Scientific Society. Vol. XI, Part I. 1894. *Chapel Hill, N. C.*, 1894. The Society.

Chicago. The Astrophysical Journal. Vol. I, No. 1. 8°. *Chicago*, 1895. Dr. W. L. Elkin.

—— Kenwood Observatory. Spectroscopic Notes. George E. Hale. 8°. [Reprint from Astronomy and Astro-Physics.] [*Northfield*, 1893.] The Author.

Digitized by Google

The Author. Chicago. The Astrophysical Journal. George E. Hale. 8°. [Reprint from the same.]
Northfield, 1894.

——— ——On some Attempts to Photograph the Solar Corona without an Eclipse. 8°. George E. Hale. [Reprint from same.]
[*Northfield*, 1894.]

The Observatory. Cincinnati. The Observatory. Publications, No. 13. Catalogue of 2000 Stars for the Epoch 1890, by Jermain G. Porter. 4°.
Cincinnati, 1895.

The Author. Coradi, G. Der harmonische Analysator. 8°.
Zürich, 1894.

J. D. and E. S. Dana. Córdoba. Resultados del Observatorio Nacional Argentino. Catálogo de las Zonas de Exploracion (Córdoba Durchmusterung). Vol. XVII, Part II, — 32° to 42°. John M. Thome, Director. 4°. [2 copies.]
Buenos Aires, 1894.

——— ——Anales de la Oficina Meteorológica Argentina por su Director, Gaulterio G. Davis. 4°. Tomo IX. Clima de Córdoba. [3 copies.]
Buenos Aires, 1893–94.

——— ——— Argentine National Observatory and Meteorological Office. Annual Report for the year 1874. 8°. *Buenos Aires*, 1875.

The Society. Dorpat. Société Astronomique Russe. Éphémérides des Étoiles. W. Döllen. 8°. [2 copies.] [*Dorpat*], 1895.

The Observatory. Durban, Natal, S. Africa. Observatory. Annual Report of the Superintendent for the year ending 1893–94. E. Nevill, Government Astronomer. 4°.
Pietermaritzburg, 1894.

The Author. Evanston. The Dearborn Observatory. On the Physical Constitution of the Planet Jupiter. G. W. Hough. 8°. [Reprint from Astronomy and Astro-Physics]. [*Northfield*, 1893.]

——— ——— Electrical Clock Connections for Operating the Chronograph. 8°. Id. [Ibid.]
[*Northfield*, ——.]

Digitized by Google

Evanston. An Electrical Control for the Equatorial. 8°. Id. [Ibid.] [*Northfield*, 1894.] — The Author.

Garavito, Julio. Principes de la Dynamique des Fluides. 8°. *Bogota*, 1895. — ——

Geneva. Société des Arts. Rapport sur le Concours pour le réglage des Chronomètres pour l'année 1893. Présenté le 19 Mars 1894. Raoul Gautier. 8°. *Geneva*, 1894. — The Observatory.

—— —— —— Pour l'année 1894. Présenté le 18 Mars 1895. Suivi d'un Supplément à la Publication "Le Service Chronométrique à l'Observatoire de Genève." 8°. *Geneva*, 1895. — ——

—— —— Concours International de Réglage pour Chronomètres de Poche de haute Précision en 1896. 8° *Geneva*, 1894. — ——

—— Le Service Chronométrique à l'Observatoire de Genève. Raoul Gautier. *Geneva*, 1894. — The Author.

Göttingen. Die Königliche Sternwarte. Astronomische Mittheilungen. 3ter Theil. Göttingen Triangulation der Plejadengruppe. 4°. *Göttingen*, 1894. — The Observatory.

Greenwich. The Royal Observatory. Astronomical and Magnetical and Meteorological Observations made in the year 1891, under the direction of W. H. M. Christie. 4°. *London*, 1893. — The Astronomer Royal.

—— —— —— 1891, Appendix. Five-year Catalogue of 258 Fundamental Stars. 4°. *London*, 1893. — ——

—— —— Assumed Mean Right Ascensions of Clock Stars with the corrections to the R. A. of the Nautical Almanac for 1895. 4°. *London*, 1895. — The Lords Commissioners of the Admiralty.

—— —— Nautical Almanac and Astronomical Ephemeris for the year 1898. 8° *London*, [1894.] — ——

—— —— Rates of Chronometers on Trial for purchase by the Board of Admiralty. 4°. *London*, 1894. — ——

Digitized by Google

The Lords Commissioners of the Admiralty. Greenwich. Rates of Deck Watches on Trial for purchase by the Board of Admiralty. 4°. *London*, 1894.

The Institution. Haarlem. Musée Teyler. Archives, Série II. Vol. IV, 3ème Partie. 4°. *Haarlem*, 1894.

The Institute. Halifax. Nova Scotian Institute of Science Proceedings and Transactions. 8°. [1st Series.] Vol. II, Part 4. *Halifax*, 1870.

—— —— —— —— —— Vol. IV, Part 4. *Halifax*, 1877–78.

—— —— —— —— —— Vol. V, Parts 1, 2 and 4. *Halifax*, 1878–82.

—— —— —— —— —— Vol. VI, Parts 2, 3 and 4. *Halifax*, 1883–86.

—— —— —— —— —— Vol. VII, Parts 1, 3 and 4. *Halifax*, 1887–90.

—— —— —— —— 2d Series. Vol. I, Parts 1 and 3. *Halifax*, 1891–93.

The Observatory. Hamburg. Die Sternwarte. Bericht, 1893. [*Hamburg*,] 1894.

The College. Havana. Observaciones Magnéticas y Meteorológicas del Real Colegio de Belen de la Compañia de Jesus. 4°. [Año de 1890.] *Havana*, 1895.

The University. —— Real Universidad de la Habana. Oracion Inaugural pronunciado en la Solemne Apertura del Curso Academico de 1894 á 1895 y Memoria-Annuario del de 1892 á 1893. 4.° *Havana*, 1894.

The Helsingfors Observatory. Helsingfors. Acta Societatis Scientiarum Fennicae. Tom. XXI, No. 8. Détermination des Constantes nécessaires pour la Réduction des Clichés pris à Helsingfors pour la Construction du Catalogue Photographique des Étoiles jusqu' à la onzième Grandeur. Anders Donner. 4°. *Helsingfors*, 1894.

The Observatory. Herény. Das Astrophysikalische Observatorium. Meteorologische Beobachtungen im Jahre 1891. 4°. *Budapest*, 1894.

Digitized by Google

Hongkong. Observations and Researches made at the Observatory in the year 1893, by W. Doberck, Director. 4°. *Hongkong*, 1894. — The Observatory.

Kasan. [Astronomical Observatory of the Imperial University.] Resultate der Beobachtungen in Kasan betreffend die Veränderlichkeit der Polhöhe. I. Beobachtungsreihe 30 April 1892–12 Juli 1893. A. M. Kowalski. 4°. *Kasan*, 1894. — ——

—— [Magnetic and Meteorological Observatory of the Imperial University.] Observations. Année 1894. 8°. *Kasan*, 1894. — ——

—— —— —— Année 1895, Janvier et Février. *Kasan*, 1895. — ——

Keeler, James E. On the Spectra of the Orion Nebula and the Orion Stars. [Reprint from Astronomy and Astro-Physics.] 8°. [*Northfield*, ———.] — The Author.

Kharkoff. Publication der Charkower Universitäts Sternwarte, Heft No. 2. Bestimmung der Längen-Differenz zwischen Nicolajew und Charkow. G. Lewitzky. 8°. *Kharkoff*, 1893. — The Observatory.

—— ——Heft No. 3. [Astronomy and the Astronomical Observatory of Kharkoff University 1843–1879.] *Kharkoff*, 1895. — ——

Kis-Kartal. [Observatory of the Baroness von Podmaniczky.] [15-year Review. Meteorology of Kis-Kartal in June 1894.] 8°. *Aszodon*, 1895. — ——

Langley, S. P. Nouvelles Recherches sur la Région infra-rouge du Spectre Solaire. 4°. [Extrait des Comptes Rendus, t. cxix.] [*Paris*] 1894. — The Author.

Leiden. Rijks Observatorium. Verslag van den Staat der Sterrenwacht te Leiden en van de aldaar volbrachte Werkzaamheden, in het Tijdvak van den 19den September 1893 tot den 18den September 1894. 8°. *Leiden*, 1894. — The Observatory.

Digitized by Google

The Observatory. Louvain. L'Université Catholique. Annuaire. 1895. 12°. *Louvain*, [1894.]

The University. Lund. Universitets Års-skrift. Tom. XXX. 1893–94. Kongl. Fysiografiska Sällskapets Handlingar. 4°. *Lund*, 1893–94.

The Observatory. ——L'Observatoire. Observations des Étoiles de la Zone entre 35° et 40° de déclinaison boréale—Réduites à l'équinoxe moyen de 1875.0 par N. C. Dunér et Folke Engström. Tome II, 4. 4°. *Lund*, 1894.

—— —— —— ——Tome II, 5. *Lund*, 1895.

—— Madison. Washburn Observatory. Publications. Vol. VII, Part 2. Meteorological Observations, 1890–93. 4°. *Madison*, 1894.

—— Madras. Results of the Observations of the Fixed Stars . . at the Government Observatory, Madras, in the years 1880, 1881 and 1882. Vol. VII. C. Michie Smith, officiating Government Astronomer. 4°. *Madras*, 1894.

—— —— ——1883, 1884, 1885, 1886 and 1887. Vol. VIII. *Madras*, 1894.

The Society. Manchester. Literary and Philosophical Society. Memoirs and Proceedings. Fourth Series. Vol. VIII, Nos. 2, 3 and 4. 8°. *Manchester*, 1893–94.

—— —— —— —— ——Vol. IX, Nos. 1 and 2. *Manchester*, 1894–95.

The Author. Marth, A. [Reprints from Mo. Not., R. A. S.]
a. Note on the Computation of the Brightness of the Planets, with some Ephemerides for Observations of the brightness of Mercury.
b. Ephemeris for Physical Observations of Mars, 1894. [Vol. LIV, No. 6.] *London*, 1894.

—— ——*a*. Ephemeris of the Satellites of Mars, 1894.
b. Ephemeris for Physical Observations of Jupiter, 1894–95. [Ibid. No. 8.] *London*, 1894.

Digitized by Google

Marth, A. *a.* Data for Computing the Positions of the Satellites of Jupiter. *b.* Ephemeris for Physical Observations of Jupiter, 1894–95 (concluded). [Ibid. No. 9.] *London*, 1894. — The Author.

——Ephemerides of the Five inner Satellites of Saturn, 1895. [Vol. LV, No. 3.] *London*, 1895. ——

Milan. R. Istituto Lombardo. [Estrato dai Rendiconti: Serie II. Vol. XXVIII.] 8°. Sull' Escursione diurna della Declinazione Magnetica a Milano in Relazione col Periodo delle Macchie Solari. Michele Rajna. *Milan*, 1895. — The Royal Observatory.

—— ——Real Osservatorio Astronomico di Brera. [Estratto dai Rendiconti: ibid.] Riassunto delle Osservazioni Meteorologiche eseguite nell' anno 1894. E. Pini. 8°. *Milan*, 1895. — The Observatory.

Morelia. Colegio Seminario. Boletin del Observatorio Meteorológico. Tomo I, Núm. 1–4. (Enero–Abril, 1895.) 4°. *Morelia*, 1805. ——

Mount Hamilton. Lick Observatory. Publications. Vol. III. 4°. *Sacramento*, 1894. ——

New York. Columbia College Observatory. Contributions. [Reprint from the Annals of the New York Academy of Sciences. Vol. VIII.] No. 6. The Parallax of η Cassiopeiæ deduced from the Rutherford Photographic Measures. Herman S. Davis. 8°. *New York*, 1895. ——

——The Jewelers' Circular and Horological Review. 4°. Vol. XXVIII, Nos. 18 to end. *New York*, 1894. — The Publishers.

—— ——Vol. XXIX. *New York*, 1894–95. ——

—— ——Vol. XXX, Nos. 1–17. *New York*, 1895. ——

——Daily Weather Maps, for 8 o'clock, P. M. Folio. *New York*, 1894–95. — U. S. Signal Office.

Northfield. Popular Astronomy. Vol. II, No. 1. 8°. *Northfield*, 1894. — Wm. L. Elkin.

Digitized by Google

The Observatory. Odessa. [University Observatory.] Organization de l'Étude Climatérique spéciale de la Russie, et Problèmes de la Météorologie Agricole. A. Klossovsky. 4°. *Odessa*, 1894.

——— ——Distribution annuelle des Orages à la Surface du Globe Terrestre. A. Klossovsky. *Odessa*, 1894.

——— O'Gyalla. [Astrophysical Observatory.] Photograph of the Observatory.

——— Oxford. Radcliffe Observatory. Catalogue of 6424 Stars for the Epoch 1890. From Observations made during the years 1880–1893. 4°. *Oxford*, 1894.

The Royal Observatory. Padua. R. Commissione Geodetica Italiana. Differenze di Longitudine fra Roma, Padova ed Arcetri. 4°. *Padua*, 1891.

Bureau des Longitudes. Paris. Connaissance des Temps—pour l'an 1897. 8° *Paris*, 1894.

——— ——Extrait à l'usage des Écoles d'Hydrographie et des Marins du Commerce, pour l'an 1896. 8°. *Paris*, 1894.

——— ——Annuaire pour l'an 1895. 12°. *Paris*, [1894.]

——— ——Ephémérides des étoiles de culmination lunaire et de longitude pour 1895, par M. M. Lœwy. 4°. *Paris*, 1894.

——— ——pour 1896. *Paris*, 1894.

——— ——Enquêtes et Documents rélatifs à l'Enseignement Supérieur. LVI. Rapport sur les Observatoires Astronomiques de Province. Année 1893. 8°. *Paris*, 1894.

The Observatory. ——Annuaire de l'Observatoire Municipal de Montsouris, pour l'année 1895. 12°. *Paris*, ——

——— Pola. Sternwarte des hydrographischen Amtes der K. u. K. Kriegsmarine. Meteorologische und Magnetische Beobachtungen. [Jan'y and Feb'y, 1895] *Vienna*, 1895.

——— Potsdam. Astrophysicalisches Observatorium. Publicationen. Director H. C. Vogel. 9ter Band. 4°. *Potsdam*, 1894.

Digitized by Google

Potsdam. Das Kgl. Geodätische Institut. Polhöhenbestimmungen im Harzgebiet. Ausgeführt in den Jahren 1887 bis 1891. 4°. *Berlin*, 1894. — The Institute.

——Internationale Erdmessung. Bericht über den gegenwäartigen Stand der Erforschung der Breitenvariation. Anlage 1 u. 2. *Berlin*, 1894. — The Bureau.

Prague. K. K. Sternwarte. Magnetische und Meteorologische Beobachtungen im Jahre 1893. 54. Jahrgang. 4°. *Prague*, 1894. — The Observatory.

——Königl. böhmische Gesellschaft der Wissenschaften. Jahresbericht, 1892. 8°. *Prague*, 1893. — The Society.

—— —— —— 1893. *Prague*, 1894. ——

—— ——Sitzungsberichte der Mathematisch-naturwissenchaftlichen Classe. Jahrgang 1892. *Prague*, 1893. ——

—— —— ——1893. *Prague*, 1894. ——

Pulcova. Observatoire Central Nicolas. Observations de Poulkova. Vol. X. Mesures Micrométriques des Étoiles Doubles. Otto Struve. 4°. *St. Petersburg*, 1893. — The Observatory.

—— ——Publications sous la Direction de Th. Brédikhine. Série II, Vol. 1. Observations faites au Cercle Vertical. M. Nyrén. *St. Petersburg*, 1893. ——

—— —— ——Déclinaisons moyennes des Étoiles Principales pour l'Époque 1885. O. M. Nyrén. 4°. [Extrait du Vol. I, Série II.] *St. Petersburg*, 1893. ——

—— ——Russische Expeditionen zur Beobachtung des Venus-Durchgangs 1874. Abtheilung I. Dr. Th. Wittram. 4°. *St. Petersburg*, 1891. ——

—— ——Tables Auxiliaires pour la Détermination de l'Heure par des Hauteurs correspondentes de différentes Étoiles. Dr. Th. Wittram. 8°. *St. Petersburg*, 1892. ——

Roberts, Dr. Isaac. Illustrations of Progress made during Recent Years in Astronomical — The Author.

Digitized by Google

Science. [Reprinted (with corrections) from Proc. Amer. Philos. Soc., Vol. XXXII.]. 8°. [*Philadelphia*, 1893.]

The Vatican Observatory. Roma. P. Francesco Denza. Cenni Necrologici. Príamo Armani. 8°. *Rome*, 1894.

The Observatory. Rugby. Report on the Temple Observatory for the year ending 1893. 8°. [*Rugby*, 1894.]

——. ——1894. [*Rugby*, 1895.]

The Academy. St. Louis. Academy of Science. Transactions. Vol. VI, No. 17. *St. Louis*, 1894.

The Institute and Observatory. San Fernando. Instituto y Observatorio di Marina. Almanaque Náutico para el año 1896. 8°. *Madrid*, 1894.

The Society. San Francisco. Astronomical Society of the Pacific. Publications. 8°. Vol. VI, Nos. 36–38. *San Francisco*, 1894.

——. ——Vol. VII, No. 39, 40. *San Francisco*, 1895.

The Observatory. San Salvador. Observatorio Astronómico y Meteorológico. Observaciones Meteorológicas correspondientes á los Meses de Octubre, Noviembre y Diciembre del Año de 1892. *San Salvador*, ——

——. ——Año de 1893. *San Salvador*, 1895.

——. Sydney. Observatory. Results of Rain, River, and Evaporation Observations made in New South Wales during 1893. H. C. Russell, Government Astronomer. 8°. *Sydney*, 1894.

——. ——[Australian Assoc. for the Adv. of Science?] The Progress of Astronomical Photography. Address by the President, H. C. Russell, Government Astronomer. [*Sydney*, 1894.]

——. Tacubaya. Observatorio Astronómico Nacional. Boletin. Tomo. I. Núm. 17–21. 4°. *Mexico*, 1894–95.

——. ——Anuario para el año de 1895. Año XV. 8°. *Mexico*, 1894.

The University. Tōkyō. Imperial University of Japan. (Teikoku Daigaku.) Calendar for the year 1893–94. 8°. *Tōkyō*, 1894.

Digitized by Google

Toronto. Meteorological Service of the Dominion of Canada. Monthly Weather Review, Nov., 1893—Dec., 1894. 4°. *Toronto*, 1894–95.	The Director.
——General Meteorological Register for the year 1894. 8°. *Toronto*, 1895.	——
——Nineteenth Annual Report; for the year 1889. 8°. *Ottowa*, 1893.	——
——The Rain and Snow Fall of the Province of Ontario. Hugh V. Payne. 8°.	——
Townley, Sidney D. Photographic Observations of Algol. 8°. [Reprint from Pub. Ast. Soc. of the Pacific, Vol. VI.] *San Francisco*, 1894.	The Author.
Uccle. Observatoire Royal. Agrandissements de Photographies Lunaires. W. Prinz. [Mt. Hamilton negatives.] Folio. *Uccle*, 1894.	The Observatory.
Upsala. University. Om Strålande Värmes Diffusion vid dess Gång genom dunkla Medier. August Falk. 8°. *Upsala*, 1893.	The University Library of Upsala.
Venice. R. Commissione Geodetica Italiana. Determinazione della Latitudine dell' Osservatorio Astronomico di Padova fatta nel 1892. Giuseppe Ciscato. 4°. *Venice*, 1894.	The Royal Observatory Padua.
——Nuova Determinazione della Latitudine dell' Osservatorio Astronomica di Padova fatta nel 1893. Giuseppe Ciscato. 4°. *Venice*, 1894.	——
——Nuovo Esame delle Condizioni del Supporto nelle Esperienze fatte a Padova nel 1885–86 per determinare la Lunghezza del Pendolo a Secondi. * * . Giuseppe Lorenzoni. 8°. *Venice*, 1893.	——
——Determinazione relativa della Gravità Terrestre a Padova, a Milano ed a Roma fatta nell' autunno 1893. Giuseppe Lorenzoni. 8°. *Venice*, 1894.	——
——Determinazione relativa della Gravità Terrestre negli Osservatori di Vienna, di Parigi e di Padova. 8°. Giuseppe Lorenzoni. 8°. *Venice*, 1893.	——

Digitized by Google

The Author. Very, Frank W. Hail Storms. A Lecture before the Pittsburgh Academy of Science and Art, January 5, 1894. [2 copies.] 8°. [*Pittsburgh*, 1894.]

The Bureau. Vienna. K. K. Gradmessungs-Bureau. Astronomische Arbeiten. Dr. Edmund Weiss und Dr. Robert Schram. VI. Band. Längenbestimmungen. 4°. *Vienna*, 1894.

The Commission. ——Œsterreichische Gradmessungs-Commission. Verhandlungen. Protokoll über die am 11. und 13. April, 1894, abgehaltenen Sitzungen. 8°. *Vienna*, 1894.

The Observatory. ——v. Kuffner'sche Sternwarte (Ottakring). Publicationen. Dr. Leo de Ball. III. Band. 4°. *Vienna*, 1894.

Office of the Am. Eph. and Naut. Almanac. Washington. American Ephemeris and Nautical Almanac. Papers prepared for the use of. Vol. V, Part III. Action of the Planets on the Moon. 4°. *Washington*, 1894.

—— —— —— —— ——Part IV. Secular Variations of the Four Inner Planets. *Washington*, 1894.

U. S. Coast and Geod. Survey. ——U. S. Coast and Geodetic Survey. Report of the Superintendent for the year ending with June, 1892, Pt. II. 8°. *Washington*, 1894.

—— —— ——Bulletins Nos. 31–33. 8°. *Washington*, 1894–95.

The Observatory. ——U. S. Naval Observatory. Instructions for observing the Transit of Mercury Nov. 10, 1894. 4°. [*Washington*, 1894.]

Branch Office, New York. ——U. S. Navy. Hydrographic Office. Pilot Charts of the North Atlantic Ocean, June, 1884–May, 1895, with 3 supplements. Folio. *Washington*, 1894–95.

Professor H. A. Newton. ——U. S. Army. Chief Engineer. Annual Reports for 1868, 1871, 1873, 1875, 1876, 1877, 1878, 1879, 1880, 1888, 1889, 1890, 1891, 1892 (with atlas, 4°) and 1893. 48 Vols. 8° and 4°. *Washington* ——

The Observatory. Windsor, N. S. W. Mr. Tebbutt's Observatory. Report for the year 1893. John Tebbutt. 8°. *Sydney*, 1894.

Digitized by Google

Windsor. Observations and Orbit-elements of Comet Gale, 1894. 8° —— 1894.

Xalapa. Observatorio Meteorológico Central del Estado de Veracruz. Boletin. Enero–Febrero 1895. Con Resumen de las Observaciones practicadas en las Estaciones del Estado en el año de 1894. 4°. *Xalapa*, 1895.

Zi-ka-wei. Shanghai Meteorological Society. Second Annual Report:—for the year 1893 on the Typhoons of that year. Rev. F. S. Chevalier, S. J. 8°. *Zi-ka-wei*, 1894.

Zurich. Astronomische Mittheilungen gegründet von Dr. Rudolph Wolf. 8°. Vol. VIII, No. LXXXIV. Herausgegeben von A. Wolfer. *Zurich*, 1894.

In addition to the foregoing there have been placed upon the Library table, shortly after publication, as loans, the following periodicals:—

By Dr. Elkin: "Astronomische Nachrichten;" "The Astronomical Journal;" "Vierteljahrsschrift der Astronomischen Gesellschaft:" "Monthly Notices of the Royal Astronomical Society," and "Science."

By another: "American Journal of Science and Arts."

THE THERMOMETRIC BUREAU.

The closing remarks of the last Annual Report may be repeated.

"Mr. Peck has continued to make the comparisons of thermometers. The general stagnation in the business affairs of the country has naturally checked the increase in the numbers of instruments sent here for verification. The number of instruments rejected by us has been rather less than heretofore, ranging from 10 to 20 per cent.—the defective ones being, apparently, more carefully culled by the makers or senders."

Very respectfully submitted,

ROBERT BROWN,

Secretary of the Observatory.

Digitized by Google

REPORT OF DR. ELKIN.

YALE UNIVERSITY, June 15, 1895.

To the Board of Managers of the Observatory:

GENTLEMEN:—In the past year the work with the Heliometer has been carried forward on the lines indicated in my past reports. I have continued and brought to what I hope is a final close the series on the parallaxes of the first magnitude stars and hope to present the definitive results in the near future. The series on the parallaxes of the large proper motion stars, on which Dr. Chase has been mainly engaged, now comprises 99 stars, all but two of which have been observed at two parallax maximum epochs, in general on three nights. It seems desirable, however, before drawing any conclusions from these data, to eliminate the effect of the proper motion, and we therefore propose to secure two further epochs for each star. In pursuance of this plan, nine stars have already been taken at a third epoch. We attempted measures of the Moon's diameter at the total eclipse of March 25, last, and measures of Mercury referred to the Sun's limb at the transit on Nov. 10, last, but in both cases the state of the sky permitted our obtaining only a small amount of results. The last contacts of the transit were, however, secured by Mr. Brown and Dr. Chase.

An agreement has been made with Dr. Gill that the observations and discussion of the *Iris* series for the determination of the solar parallax should be printed and included with his similar investigations on *Victoria* and *Sappho*, and the papers have been forwarded to him. In revising the work for final publication I have found that the distances of the planet from the Sun used probably require a small correction and that an observation was included which did not refer to the planet. The effect of the requisite emendations is to slightly reduce the value of the solar parallax given in my last report as the result of the *Iris* series.

The reductions of the *Coma Berenices* triangulation have been completed practically, and the work will shortly be ready for the press. I regret to say that, owing to a long and serious

Digitized by Google

illness of Dr. Palmer, considerable work yet remains to be done on the Jupiter satellite series.

The equatorial mounting constructed for us by Warner and Swasey for carrying a number of cameras, reached us at the end of July last, and was set up in time to be used on three nights of the August meteor period, August 9, 10 and 11. It carried four cameras, two with lenses of about 6 inches, and two with such of about 5 inches effective aperture, and these four fields were exposed in all about 11 hours. I must confess to some considerable disappointment in finding only two meteor trails on our plates as a result of this first trial of our new apparatus, but I hope with added experience and care to be more fortunate this coming season. We also made exposures on the dates of the November and December showers, but with only negative results, owing possibly partly to the unfavorable position of the moon.

It seems to me, however, that as other observers begin to take up such work, we will eventually be able to reach some valuable results from the photographic data as they accumulate. Already we are in possession of some twelve impressions of Perseid trails, four of which were secured here and two at Ansonia by Mr. John E. Lewis working in collaboration with us. Prof. Barnard has furthermore kindly sent us three plates exposed also on Aug. 9, 10 and 11, 1894, for about 8 hours in all, which show four and possibly five meteor trails. And finally Prof. Pickering has found on an examination of the Harvard Observatory plates one fine trail on a plate taken Aug. 8, 1893, and kindly sent it to us for measurement. I have carried out a discussion of these trails, which will be very shortly ready for publication and seems to lead to some interesting conclusions.

Respectfully,

W. L. ELKIN,

Astronomer in charge of the Heliometer.

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Sci 772.5
.4

REPORT FOR THE YEAR 1895–96, PRESENTED BY THE BOARD OF MANAGERS OF THE OBSERVATORY OF YALE UNIVERSITY TO THE PRESIDENT AND FELLOWS.

Digitized by Google

HARVARD COLLEGE LIBRARY,
JUL 30 1896
CAMBRIDGE, MASS.

OBSERVATORY OF YALE UNIVERSITY.

BOARD OF MANAGERS.

Rev. TIMOTHY DWIGHT, D.D., LL.D., *President.*
Professor HUBERT A. NEWTON, LL.D., *Secretary.*
WILLIAM W. FARNAM, M.A.
THOMAS G. BENNETT, PH.B.
Professor CHARLES S. HASTINGS, PH.D.

OFFICERS.

ROBERT BROWN, M.A., *Secretary.*
* WILLIAM L. ELKIN, PH.D., *Astronomer in charge of the Heliometer.*
FREDERICK L. CHASE, PH.D., *Assistant Astronomer.*

* While this Report is in the hands of the printers, Dr. Elkin has, in his absence, been made Director of the Observatory.

Digitized by Google

REPORT.

YALE UNIVERSITY, June 22, 1896.

To the President and Fellows of Yale University:

GENTLEMEN:—The Board of Managers herewith transmit the reports of Mr. Brown, the Secretary of the Observatory, and of Dr. Elkin, the Astronomer in charge of the Heliometer. The clocks and the time signals have been under the care of Dr. Chase.

Respectfully submitted by

THE BOARD OF MANAGERS.

Digitized by Google

SECRETARY'S REPORT.

YALE UNIVERSITY OBSERVATORY,
NEW HAVEN, CONN., June 17, 1896.

To the Board of Managers:

GENTLEMEN:—I have the honor to report for the year ending with May 31, 1896, as follows:

THE OBSERVATORY BUILDING.

The re-painting of the outside of the building, in progress at the time of my last report, has been continued, at intervals. The furnace was patched and made to last through the winter; probably parts of the furnace will require to be replaced before the coming winter.

A dark closet for photographic uses was constructed by partitioning off the west side of the north-east chamber on the second floor, by means of Neponset building paper on light scantlings; light from gas burners in the adjacent room being admitted through appropriately colored windows, and the north window being darkened.

THE OBSERVATORY GROUNDS.

The water conductors on the south side of the Transit Room were connected with the sewer drain on this side of the building, in like manner as reported last year concerning the north side. The bottom of this connecting drain is, at the line of the building, 49 inches below ground, and is planned to drain off any water that may accumulate at that depth about the piers of the transit instrument. The plans of these drains will be found on pages 43 and 44 of Letter Book, No 4.

A few trees injured by boring insects were replaced, and a few small trees added to the grounds—including a horse chestnut and an ash-leaved Negundo, west of the north-east drive. On the north-east side of the north-west drive a little regrading was done.

GROUND NORTH OF CANNER STREET.

An elm tree on St. Ronan Street next north of Canner Street was replaced, as also one on the north side of Canner Street near the top of the hill. The City authorities have at length required sidewalks to be laid this summer, from St. Ronan Street, eastward, which will make the lots on St. Ronan Street more accessible and more marketable. This is certain at no distant day to become a beautiful street.

Digitized by Google

The contributions to the Library of the Observatory during the year ending with May 31st, 1896, have been as follows :

Adelaide. Circular announcing the establishment of the Perth (W. Australia) observatory. f°. *Adelaide*, 1895.	The Adelaide Observatory.
Berlin. Das Königlich Preussische Geodätische Institut. Astronomisch-Geodätische Arbeiten I. Ordnung. Telegraphische Längenbestimmungen in den Jahren 1890, 1891 und 1893. 4°. *Berlin*, 1895.	The Institute.
Bonn. Königliche Sternwarte. Veröffentlichungen. No. I. Beobachtungen von Nebelflecken, von Dr. C. Mönnichmeyer. 4°. *Bonn*, 1895.	The Observatory.
Boston. American Academy of Arts and Sciences. Proceedings. New Series. Vol. XXII. 8°. *Boston*, 1895.	The Academy.
—— Public Library. Forty-third Annual Report. For 1894. *Boston*, 1895.	The Library.
Bruxelles. L'Académie Royale des Sciences des Lettres et des Beaux Arts. Annuaire. 1894. 60me Année. 8°. *Bruxelles*, 1894.	The Academy.
—— —— —— 1895. 61me Année. 8°. *Bruxelles*, 1895.	——
—— —— Bulletins. 63me Année. 3ime Série, Tome XXVI. 8°. *Bruxelles*, 1893.	——
—— —— —— 64me Année, 3me Série, Tome XXVII. 8°. *Bruxelles*, 1894.	——
—— —— —— 64me Année, 3me Série, Tome XXVIII. 8°. *Bruxelles*, 1894.	——
—— —— —— 65me Année, 3me Série, Tome XXIX. 8°. *Bruxelles*, 1895.	——
Bucharest. Institutul Meteorologic. Analele. Tomul IX, Anul 1893. 4°. *Bucharest*, 1895.	The Institute.
Buffalo. Medical and Surgical Journal. June, 1895–May, 1896. 8°. *Buffalo*, 1895–96.	The Publishers.
Cambridge. The Astronomical Observatory of Harvard College. Annals. 4°. Vol. XXXIV. A Catalogue of 7922 Southern Stars observed with the Meridian Photometer during the years 1889–91, by Solon I. Bailey. *Cambridge*, 1895.	The Observatory.

Digitized by Google

The Observatory. —— —— —— Vol. XL, Part IV. Observations made at the Blue Hill Meteorological Observatory in the year 1894. Under the direction of A. Lawrence Rotch, A. M. *Cambridge*, 1895.

—— —— —— —— Vol. XLI, No. III. Observations of the New England Weather Service in the year 1894. By J. Warren Smith. *Cambridge*, 1895.

—— —— —— Fiftieth Annual Report of the Director. 8°. *Cambridge*, 1895.

The Author. Cañete del Pinar—el Conde de. Observaciones de precision con el Sextante. 8°. *Madrid*, 1895.

The Observatory. Cape of Good Hope. Royal Observatory. Results of Meridian Observations of Stars, made from 1885 August to 1887 December, under the direction of David Gill, LL.D. 4°. *London*, 1894.

—— —— —— Catalogue of 1,713 Stars for the Equinox 1885. o. From Observations made during the years 1879 to 1885. With—

I, Catalogue of 104 Southern Circumpolar Stars.

II, Separate Observations of β, α_2 and α_1 Centauri. 4°. *London*, 1894.

—— —— —— Report of Her Majesty's Astronomer at the Cape of Good Hope, for the year 1894. 4°. *London*, 1895.

The Society. Chapel Hill. Journal of the Elisha Mitchell Scientific Society. Vol. XI, Second Part, 1894. 8°. *Chapel Hill, N. C.*, 1894.

—— —— —— Vol. XII, Part First, 1895. *Chapel Hill, N. C.*, 1895.

The Commission. Christiania. Norwegische Commission der Europäischen Gradmessung. Resultate der im Sommer 1893 in dem nördlichsten Theile Norwegens ausgeführten Pendelbeobachtungen. O. E. Schiötz. 8°. *Christiania*, 1894.

Digitized by Google

Christiania. Resultate der in Sommer 1894 in dem südlichsten Theile Norwegens ausgeführten Pendelbeobachtungen. O. E. Schiötz. 8°. *Christiania*, 1895. — The Commission.

—— —— Astronomische Bebachtungen und Vergleichung der astronomischen und geodätischen Resultate. 4°. *Christiania*, 1895. — ——

Christie, Alexander Smyth. The Latitude—Variation Tide. [Reprint from the Philosophical Society of Washington, Bulletin, Vol. XIII. 8°. *Washington*, 1895. — The Author.

Copenhagen. Unders®gelser over Instrumentkonstanter ved Kj®benhavns Universitets astronomiske Observatoriums Maaleapparat for fotograviske Plader. Carl Burrau. 4°. *Copenhagen*, 1895. — The Copenhagen Observatory.

—— Recherches numériques concernant des solutions périodiques d'un cas spécial du problème des trois corps. I et II. Carl Burrau. 4°. [Abdruck aus Bd. 135 und 136 der Astr. Nachr.] *Kiel*, 1894. — ——

—— —— Troisième mémoire. T. N. Thiele. 4°. [Abdruck aus den Astr. Nachr. Bd. 138.] *Kiel*, 1895. — ——

Dresden. Observatoire de B. D'Engelhardt. Observations Astronomiques. Part III. 4°. *Dresden*, 1895. — The Observatory.

Göttingen. Königliche Sternwarte. Astronomische Mittheilungen. 4ter Theil. Die Oerter der helleren Sterne der Praesepe. W. Schur. 4°. *Göttingen*, 1895. — ——

Greenwich. Royal Observatory. Astronomical and Magnetical and Meteorological Observations made in the year 1892, under the direction of W. H. M. Christie. 4°. *London*, 1894. — The Astronomer Royal.

—— —— Reduction of Greenwich Meteorological Observations, Part III. Temperature of the air 1841 to 1890. 4°. *London*, 1895. — ——

Digitized by Google

The Lords Commissioners of the Admiralty. Greenwich. Assumed Mean Right Ascensions of Clock Stars with the corrections to the R. A. of the Nautical Almanac for 1896.0. 4°. *London*, 1895.

——— —— —— Nautical Almanac and Astronomical Ephemeris for the year 1899. 8° *London*, 1895.

——— —— —— Rates of Chronometers on Trial for purchase by the Board of Admiralty. 4°. *London*, 1895.

——— —— —— Rates of Deck Watches on Trial for purchase by the Board of Admiralty. 4°. *London*, 1895.

The Institution. Haarlem. Musée Teyler. Archives, Série II. Vol. IV, 4eme Partie. 4°. *Haarlem*, 1895.

The Authors. Halifax, England. A Handbook of Double Stars. By Edward Crossley, Joseph Gledhill and James M. Wilson. 8°. *London*, 1879.

——— —— —— Corrections, with Notes, Criticisms, etc., to the Handbook of Double Stars. By Edward Crossley, Joseph Gledhill and James M. Wilson. 8°. *London*, 1880.

The Institute. Halifax, Nova Scotia. Nova Scotian Institute of Science. Proceedings and Transactions. 8°. 2d Series. Vol. VIII, Part 4. *Halifax*, 1895.

The Observatory. Hamburg. Die Sternwarte. Bericht, 1894. [*Hamburg*,] 1895.

——— —— —— Mittheilungen. 8°. No. 1. Positionsbestimmungen von Nebelflecken und Sternhaufen.

——— —— —— —— No. 2. Bahnbestimmung des Planeten (258) Tyche. *Hamburg*, 1895.

The College Havana. Real Colegio de Belen de la Compañia de Jesus. Observaciones Magnéticas y Meteorológicas. Año de 1891. 4°. *Havana*, 1895.

——— —— —— Investigaciones relativas a la circulacion y traslacion ciclónica en los huracanes de las Antillas. P. Benito Viñes, S. J., Director. 8°. *Havana*, 1895.

Digitized by Google

Helsingfors. [Aftrycken ur Finska Vet. Soc. Förhandlingar. B. XXXVII, 1895. 8°.] Redogörelse för fortgången af de Astrofotografiska arbetena å observatoriet i Helsingfors under tiden Juni 1893–Maj 1894. Anders Donner. *Helsingfors*, 1895. — Helsingfors Observatory.

—— —— Juni 1894 till Maj 1895. *Helsingfors*, 1895. ——

Hongkong. Observations and Researches made at the Observatory in the year 1894, by W. Doberck, Director. 4°. *Hongkong*, 1895. — The Observatory.

Kalocsa. Publicationen des Haynald-Observatoriums. VII. Heft. Meteorologische Beobachtungen. Boroma, S. Africa 1891–2. 4°. *Kalocsa*, 1896. ——

Kasan. [Magnetic and Meteorological Observatory of the Imperial University.]. Observations. Année 1895, Mars-Août. 8°. *Kasan*, 1895. ——

Keeler, James E. [Reprints from the Astrophysical Journal, May and June, 1895. 8°.] A Spectroscopic Proof of the Meteoric Constitution of Saturn's Rings. — The Author.

—— Conditions Affecting the Form of Lines in the Spectrum of Saturn. *Chicago*, 1895. ——

Kis-Kartal. [Observatory of the Baroness von Podmaniczky.] [Observations October, 1893–October, 1895.] 8°. *Budapest*, 1895. — The Observatory.

Leipzig. Fürtstlich Jablonowski'sche Gesellschaft. XXXI. Die Säcularen Veränderungen der Bahnen der Grossen Planeten. Paul Harzer. *Leipzig*, 1895. — The Ducal Observatory, Gotha.

—— Sächsische Gesellschaft der Wissenschaften. Abhandlungen der Mathematisch-physichen Classe. 8°. Band XXI, No. V. Das Eikonal. Heinrich Bruns. *Leipzig*, 1895. — The Leipzig Observatory.

—— —— —— Band XXII, No. IV. Beobachtungen am sechszölligen Repsoldschen Heliometer der Leipziger Sternwarte. Bruno Peter. *Leipzig*, 1895. ——

*

Digitized by Google

The University. Louvain. L'Université Catholique. Annuaire pour l'an 1896. 12°. *Louvain*, [1895.]

—— Lund. Universitets Års-skrift. Tom. XXXI. 1895. Kongl. Fysiografiska Sällskapets Handlingar. 4°. *Lund*, 1895.

The Observatory. Madison. Washburn Observatory. Publications. Vol. IX. 4°. *Madison*, 1896.

The Academy. Madrid. Real Academia de Ciencias Exactas, Físicas y Naturales. Memorias, Tomo XVI. Estudio sistemático de las bases orgánicas de origen animal. D. José Úbeda y Correal. Roy. 8°. *Madrid*, 1895.

The Society. Manchester. Literary and Philosophical Society. Memoirs and Proceedings. Fourth Series. Vol. IX, Nos. 3, 4, 5 and 6. 8°. *Manchester*, 1895.

—— —— —— —— —— Vol. X, Nos. 1 and 2. *Manchester*, 1896.

The Author. Marth, A. [Reprints from Mo. Not., R. A. S. 8°.] Ephemeris for Physical Observations of Jupiter, 1895–96. [Vol. LV, No. 8.] *London*, 1895.

—— —— —— *a*. Same. (Concluded.)

b. Data for Computing the Positions of the Satellites of Jupiter, 1895–96. [Ibid. No. 9.] *London*, 1895.

—— —— —— Ephemeris for Physical Observations of the Moon, 1896. [Vol. LVI, No. 3.] *London*, 1896.

The Observatory. Milan. R. Osservatorio Astronomico. Sull' Apparato Esaminatore di Livelle, costruito dal sig. L. Milani nel 1889. Nota di Michele Rajna. 8°. [Estratto dal Periodico Il Politecnico.] *Milan*, 1895.

—— —— Reale Osservatorio di Brera. Publicazioni. 4°.

No. XXXVIII. Sulla Teoria dei Cicloni. Luigi de Marchi. *Milan*, 1893.

—— Morelia. Colegio Seminario. Boletin del Observatorio Meteorológico. Tomo I, Núm. 5–14. Mayo, 1895–Febrero, 1896. *Morelia*, 1895–96.

Digitized by Google

Mount Hamilton. Lick Observatory. Contributions. 8°. No. 4. Report of the Total Eclipse of the Sun, observed at Mina Bronces, Chile, on April 16, 1893. *Sacramento*, 1895.	The Observatory.
—— —— —— No. 5. Meteors and Sunsets, 1893, 1894 and 1895. *Sacramento*, 1895.	——
New York. Columbia College Observatory. Contributions. No. 7. [Reprint from the Annals of the New York Academy of Sciences. Vol. VIII.] The Rutherfurd Photographic Measures of Sixty-two Stars about η Cassiopeiæ. Herman S. Davis. 8°. *New York*, 1895.	——
—— —— —— No. 8. [Reprint of Memoir I of the New York Academy of Sciences.] The Variation of Latitude at New York City. John K. Rees, Harold Jacoby and Herman S. Davis. Part I. Declinations and Proper Motions of Fifty-six Stars. Herman S. Davis. 4°. *New York*, 1895.	——
—— The Jewelers' Circular and Horological Review. 4°. Vol. XXX, Nos. 18 to end. *New York*, 1895.	The Publishers
—— ——Vol. XXXI. *New York*, 1895–96.	——
—— ——Vol. XXXII, Nos. 1–17. *New York*, 1896.	——
Nice. Fondation R. Bischoffsheim. Annales de l'Observatoire. M. Perrotin, Directeur. Tome IV. 4°. *Paris*, 1895.	The Observatory.
—— —— —— —— Tome V. 4°. *Paris*, 1895.	——
Oxford. University Observatory. 19th Annual Report of the Savilian Professor of Astronomy. 8°. [*Oxford*, 1894.]	——
—— —— 20th Annual Report. [*Oxford*, 1895.]	——
Padua. Atti e Memorie della R. Accademia di Scienze, Lettere ed Arti. 8°. Anno CCXCV (1893–94), Nuova Serie. Vol. X. *Padova*, 1894.	The Academy.
Palermo. Reale Accademia di Scienze, Lettere e Belle Arti. Bullettino. 4°. Anno VIII. Num. 4–6, 1891. Luglio—Dicembre. *Palermo*, 1892.	——

Digitized by Google

The Academy. Palermo. —— —— Anno IX. Num. 4–6, 1892. Luglio–Dicembre. *Palermo*, 1893.

—— —— —— —— Anno X. Num. 1–6, 1893. Gennaio–Dicembre. *Palermo*, 1894.

—— —— —— Atti. 4°. Terza Serie. Anno 1892. Vol. II. *Palermo*, 1893.

—— —— —— Terzo Centenario della morte di Torquato Tasso. 4°. *Palermo*, 1895.

The Observatory. Paris. Annuaire de l'Observatoire Municipal de Montsouris, pour l'année 1896. 12°. *Paris*, ——

—— Parsonstown. Observatory of the Earl of Rosse. The Radiant Heat from the Moon during the Progress of an Eclipse. [Reprint from the Proc. Roy. Inst. of Gt. Brit. 1895.] 8°. *London*, 1895.

—— Pola. Sternwarte des hydrographischen Amtes der K. u. K. Kriegsmarine. Meteorologische und Magnetische Beobachtungen. [März–December, 1895.] 4°. *Vienna*, 1895.

—— —— —— Meteorologische Termin-Beobachtungen in Pola und Sebenico. Jänner–März, 1896. 4°. *Vienna*, 1896.

—— Potsdam. Astrophysicalisches Observatorium. Publicationen. Director H. C. Vogel. 7ter Band. II Theil. 4°. *Potsdam*, 1895.

—— —— —— —— 10ter Band. 4°. *Potsdam*, 1895.

The Institute. —— Das Kgl. Geodätische Institut. Telegr. Längenbestimmungen in den Jahren 1890, 91, and 93. 4°. *Berlin*, 1895.

The Bureau. —— Internationale Erdmessung. Bericht über den gegenwärtigen Stand der Erforschung der Breitenvariation. *Berlin*, 1895.

The Observatory. Prague. K. K. Sternwarte. Magnetische und Meteorologische Beobachtungen im Jahre 1894. 55. Jahrgang. 4° *Prague*, 1895.

The Society. —— Königl. böhmische Gesellschaft der Wissenschaften. Jahresbericht für das Jahr 1894. 8°. *Prague*, 1895.

—— —— —— Sitzungsberichte der Mathematisch-naturwissenchaftlichen Classe. Jahrgang 1894. 8°. *Prague*, 1895.

Digitized by Google

Quito. Observatorio Astronomico. Boletin. Num. 1–4. 8°. *Quito*, 1895.	The Observatory.
Richmond, England. Kew Observatory. Report of the Incorporated Kew Committee for the Year ending December 31, 1894. 8°. *London*, 1894.	——
—— —— —— 1895. 8°. *London*, 1896.	——
Rome Specola, Vaticana. Pubblicazioni. Vol. IV. 4°. *Rome*, 1894.	——
—— Reale Accademia dei Lincei. (Anno CCXCI. 1894.) Catalogo delle ascensioni rette medie pel 1890, o di 2438 stelle comprese fra l'equatore ed il parallelo 8° nord, e di 45 stelle dell' emisfero australe osservate al Circolo Meridiano del R. Osservatorio del Campidoglio negli anni 1885–90, da A. di Legge e F. Giacomelli. 4°. *Rome*, 1894.	——
Rugby. The Temple Observatory. Further Measures of Double Stars during the Years 1890–95. G. M. Seabroke and P. Highton. [Reprint from Mem. R. A. S., Vol. LI.] 8°. *London*, 1895.	——
St. Louis. Academy of Science. Transactions. 8°. Vol. VI, No. 18. *St. Louis*, 1895.	The Academy.
—— —— —— Vol. VII, Nos. 1–5. *St. Louis*, 1895–96.	——
San Fernando. Institutio y Observatorio di Marina. Almanaque Náutico para el año 1897. 8°. *Madrid*, 1895.	The Institute and Observatory.
—— ——Anales. Observaciones Astronómicas. Año 1892. 4°. *San Fernando*, 1896.	——
San Francisco. Astronomical Society of the Pacific. Publications. 8°. Vol. VII, Nos. 41–45. *San Francisco*, 1895.	The Society.
—— —— —— Vol. VIII, Nos. 46–49. *San Francisco*, 1896.	——
San Salvador. Observatorio Astronómico y Meteorológico. Anales. 1895. *San Salvador*, 1895.	The Observatory.

Digitized by Google

The Central Observatory. San Salvador. Alberto Sanchez. La Cornoide. 8°. *San Salvador*, 1895.

The Society. Shanghai. Meterological Society. Third Annual Report; for the Year 1894. 8°. *Shanghai*, 1895.

The Author. Singleton, M. T. Gravitation and Cosmological Law. 8°. *Atlanta*, 1895.

Royal Academy of Sciences, Stockholm. Stockholm. Observatorium. Astronomiska Iakttagelser och Undersökningar anstälda på Stockholms Observatorium. Utgifna af Hugo Gyldén, Konigl Vetenskaps-Akademiens Astronom. 4°. 5*e* Bandet, Häften 1–4. *Stockholm*, 1893–95.

The Observatory. Sydney, N. S. W. Government Observatory. Results of Rain, River, and Evaporation Observations made in New South Wales during 1892. H. C. Russell, Government Astronomer. 8° *Sidney*, 1893.

—— —— —— Recent Measures of Double Stars, made at Sidney. By H. C. Russell, Government Astronomer [Abdruck aus den Astr. Nachr. Bd. 135]. 4°. *Kiel*, 1894.

—— —— —— A Chart of Southern Circumpolar Stars; Fol. — with paper read before the Royal Society of N. S. Wales. H. C. Russell, Government Astronomer. 8°. *Sydney*, 1894.

—— Tacubaya. Observatorio Astronómico Nacional. Boletin. Tomo I. Núm. 22–24. 4°. *Mexico*, 1895–96.

—— —— —— Anuario para el año de 1896. Año XVI. 8°. *Mexico*, 1895.

The University. Tōkyō. Imperial University of Japan. Teikoku Daigaku.) Calendar for the year 1894–95. 8°. *Tōkyō*, 1895.

The Observatory. —— —— Observatoire Astronomique. Annales, Tome I. 3^{me} Fascicule. 4°. *Tōkyō*, 1894.

The Director. Toronto. Meteorological Service of the Dominion of Canada. Monthly Weather Review, Jan.—Oct., 1895. 4°. *Toronto*, 1895–96.

Digitized by Google

Toronto. The Canadian Institute. Transactions. 1891–92. Vol. IV, Part 2. 8°. *Toronto*, 1895. — The Institute.

—— The University. The Functions of a Great University. Inaugural Address by J. M. Clark, President of the Univ. Coll. Lit. and Sci. Soc. 8°. *Toronto*, 1895. — The Author.

Turin. Osservatorio della R. Università di Torino. Osservazioni Meteorologiche fatte nell' anno 1893, calcolate dal Dot. G. B. Rizzo. 8°. *Turin*, 1894. — The Observatory.

—— —— —— nell' anno 1894. *Turin*, 1895. ——

—— —— Effemeridi del Sole e della Luna per l'orrizonte di Torino e per l'anno 1896, calcolate dal Dottor Vittorio Balbi. 8°. *Turin*, 1895. ——

—— —— Sul modo di dedurre la media giornaliera delle osservazione meteorologiche. 8°. *Turin*, 1895. ——

—— Sull' estensione della legge di Kirchhoff intorno alla relazione fra l'assorbimento e l'emissione della luce. Nota del Dottore G. B. Rizzo. *Turin*, 1894. ——

Veeder, M. A. Magnetic Storms and Sunspots. Folio. *Lyons, N. Y.*, 1895. — The Author.

Very, Frank W. Photometry of a Lunar Eclipse. [Reprint from the Astrophysical Journal.] 8°. *Chicago*, 1895. ——

Vienna. Œsterreichische Gradmessungs-Commission. Verhandlungen. Protokolle über die am 9. April und 24. Juni 1895, abgehaltenen Sitzungen. 8° *Vienna*, 1895. — The Commission.

—— —— Astronomische Arbeiten [Publicationen für die Internationale Erdmessung.] Bestimmung der Polhöhe und des Azimutes auf den Stationen Spieglitzer Schneeberg, Hoher Schneeberg und Wêtrnik. Ausgeführt von Dr. Josef Herr. 4°. *Vienna*, 1895. ——

—— K. und K. Reichs-Kriegs-Ministerium, Marine-Section. Relative Schwerebe- — The Ministry.

Digitized by Google

stimmungen durch Pendelbeobachtungen. Ausgeführt in den Jahren 1892–1894. 8°. *Vienna*, 1895.

The Author. Virginia,—University of. The Great Inequality of Jupiter and Saturn. Edgar Odell Lovett. [Reprint from the Astronomical Journal, No. 351.] 4°. *Boston*, 1895.

Office of the Am. Eph. and Naut. Almanac. Washington. American Ephemeris and Nautical Almanac for the year 1898. 8°. *Washington*, 1895.

—— —— —— Astronomical Papers prepared for the use of. Vol. VI, Part I. Tables of the Sun. 4°. *Washington*, 1895.

—— —— —— —— —— Part II. Tables of Mercury. 4°. *Washington*, 1895.

—— —— —— —— Vol. VII, Part I. Tables of Jupiter. 4°. *Washington*, 1895.

—— —— —— —— —— Part II. Tables of Saturn. 4°. *Washington*, 1895.

U. S. Coast and Geod. Survey. —— U. S. Coast and Geodetic Survey. Report of the Superintendent for the year ending with June, 1893, Pt. II. 8°. *Washington*, 1895.

—— —— —— Bulletin No. 34. 8°. *Washington*, 1895.

The Observatory. Windsor, N. S. W. Mr. Tebbutt's Observatory. Report for the year 1894. John Tebbutt. 8°. *Sydney*, 1895.

—— —— —— —— 1895. 8°. *Sydney*, 1896.

—— Xalapa. Observatorio Meteorológico Central del Estado de Veracruz Llave. Boletin Mensual. Mayo, 1895.—Febrero, 1896. 4°. *Xalapa*, 1895 [–96.]

—— Zi-ka-wei. L'Observatoire Magnétique et Météorologique. Bulletin Mensuel. Tome XIX. Année 1893. 4°. *Zi-ka-wei*, 1895.

—— Zurich. Astronomische Mittheilungen gegründet von Dr. Rudolph Wolf. 8°. Vol. VIII. Nos. LXXXV und LXXXVI. Herausgegeben von A. Wolfer. *Zürich*, 1895.

Digitized by Google

In addition to the foregoing there have been placed upon the Library table, shortly after publication, as loans, the following periodicals :—

By Dr. Elkin : " Astronomische Nachrichten ;" " The Astronomical Journal ;" " Vierteljahrsschrift der Astronomischen Gesellschaft ;" " Monthly Notices of the Royal Astronomical Society," and " Science."

By others : "American Journal of Science and Arts " and " Knowledge."

THE THERMOMETRIC BUREAU.

The number of thermometers received for verification, and proportion rejected remain about the same. Mr. Peck, besides making these comparisons, as heretofore, has given considerable time to the consideration of the most feasible and most accurate methods of determining temperatures between 100° and 300° C., for which there is some demand, and where the limit of accuracy is larger than we are satisfied to have it remain.

Very respectfully submitted,

ROBERT BROWN,

Secretary of the Observatory.

REPORT OF DR. ELKIN.

YALE UNIVERSITY, May 1, 1896.

To the Board of Managers of the Observatory :

GENTLEMEN :—The series of measures for the purpose of detecting possible large parallaxes of stars with large proper motion has been carried on during the past year by Dr. Chase and myself. A few stars have been added to the list to fill up the gaps which presented themselves in the course of observing. As at present planned, the work will be completed probably in the course of 1897, as far as the observations are concerned.

Digitized by Google

The series on the parallaxes of the first magnitude stars is, as stated in my last report, practically brought to a close, and only a few points of discussion remain to be revised.

A considerable portion of my time has been devoted to a final revision of the discussion of the work on Iris as it passed through the press. This has now been accomplished, and the work will shortly appear as Part IV of the work issued by Dr. Gill on the determination of the Solar Parallax by Heliometer measures of Asteroids.

Dr. Chase has passed through the press his work on the relative places of the principal stars in the cluster in Coma Berenices, and it is ready for issue as Part V of our Transactions.

I regret to say that we were not successful in the past season in securing photographic records of meteor trails. The apparatus was put in use during several nights of the August showers, but no meteors appeared of sufficient brilliancy to impress themselves on the plates, which had necessarily become somewhat fogged by the strong moonlight. We were equally unfortunate in our attempts on the Leonids and Geminids in November and December, respectively. During this year we have had only two lenses in use, as no further ones of sufficient size and quality were to be found in the market. It seems wise, however, in view of the favorable chances for the Perseids this year, and the approaching maximum of the Leonids, to make an especial effort to secure a complete battery for our mounting as originally planned.

Respectfully,

W. L. ELKIN,

Astronomer in charge of the Heliometer.

Digitized by Google

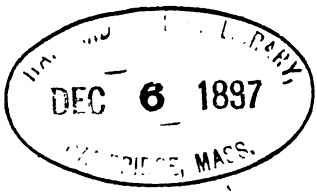
Digitized by Google

Digitized by Google

Sci 772.5

Report for the year 1896–97, presented by the Board of Managers of the Observatory of Yale University to the President and Fellows.

Digitized by Google



OBSERVATORY OF YALE UNIVERSITY.

BOARD OF MANAGERS.

Rev. TIMOTHY DWIGHT, D.D., LL.D., *President.*
WILLIAM W. FARNAM, M.A.
THOMAS G. BENNETT, PH.B.
Professor CHARLES S. HASTINGS, PH.D.

OFFICERS.

WILLIAM L. ELKIN, PH.D., *Director.*
ROBERT BROWN, M.A., *Secretary.*
FREDERICK L. CHASE, PH.D., *Assistant Astronomer.*

Digitized by Google

REPORT.

YALE UNIVERSITY, June 26, 1897.

To the President and Fellows of Yale University:

GENTLEMEN:—The Board of Managers herewith transmit the Reports of Dr. Elkin, who was appointed Director of the Observatory at the meeting of the Corporation in June, 1896, and of Mr. Brown, Secretary of the Observatory.

Since the date of our last report we have lost by the death of Professor Hubert A. Newton one of our earliest as well as one of our most efficient members. Professor Newton had, from the very first inception of the plan which resulted in the establishment of the Observatory, felt the deepest interest in it and manifested his interest by his constant thoughtfulness and effort in its behalf. From 1882 to 1884 he held the office of Director, and after resigning the position he continued to discharge a large part of the duties connected with it. This he did without compensation, and he furthermore aided generously in the effort to maintain the Observatory in the first years of its existence. For these invaluable services the Board of Managers wish to express their sense of deepest recognition.

Respectfully submitted by

THE BOARD OF MANAGERS.

Digitized by Google

REPORT OF DR. ELKIN.

YALE UNIVERSITY, June 23, 1897.

To the Board of Managers of the Observatory:

GENTLEMEN:—I returned from abroad early in July last in time to prepare for photographing the August meteors.

While in Europe I purchased a third Voigtländer lens and one by Hermagis, both of six inches aperture, and since my return have procured two other similar ones of American make, thus making six cameras available on our mounting. The cost of all three of our Voigtländer lenses has been generously defrayed by Cyprian S. Brainerd, Esq. Five lenses were put in use in August last and eight meteor trails, five of them Perseids, were secured. The November and December periods were, however, unproductive this year.

A considerable part of my time has been employed in the measurement and discussion of the photographic trails of the Perseids thus secured, now numbering 17 in all. So far, the results are not very conclusive as to the character of the radiant, but as each year, we trust, will add to our data, there seems good reason to hope ultimately for most valuable deductions. Mr. John E. Lewis has rendered valuable coöperation in this work, though he did not secure any trails at Ansonia.

I regret to have to say that owing to a severe attack of influenza I have otherwise been obliged to curtail my observing work during most of the year, devoting myself to arrears of discussion and reduction, and have had to be absent from New Haven in the spring months in a more Southern climate.

During the winter, however, a portion of the work on the parallaxes of the ten first magnitude stars in the Northern Hemisphere, comprising the observations and reductions, has been passed through the press. In anticipation of the complete publication of the work I may say that, without entering into further details, the following are values which can hardly be modified appreciably by further discussion:

Digitized by Google

Star.	Parallax.	Prob. Error.	No. of Series.	No. of Stars.	No. of Obs.
α Tauri	+0".107	±0".013	9	18	171
α Aurigae	+0.081	0.016	4	7	57
α Orionis	+0.023	0.017	3	6	48
α Canis minoris	+0.325	0.018	7	13	128
β Geminorum	+0.056	0.016	3	6	48
α Leonis	+0.022	0.022	5	12	74
α Bootis	+0.024	0.015	7	13	126
α Lyrae	+0.082	0.014	7	14	143
α Aquilae	+0.231	0.019	5	14	79
α Cygni	—0.012	0.015	3	7	49

Dr. Chase was absent in Europe on leave from July, 1896, to January, 1897. Since his return he has taken up the Heliometer work on the parallaxes of large proper motion stars and prosecuted it with great devotion and energy—in addition to carrying on the time service and teaching one term in the Scientific School. During his absence the time service was under the care of Mr. George K. Lawton until October, 1896, and subsequently under that of Dr. B. W. McFarland.

Dr. Palmer has been engaged in computations, mainly of refraction corrections and tables therefor. Miss Newton has been occupied in preparing a series of references to other catalogues in an interleaved copy of the Bonn Durchmusterung.

Respectfully,

W. L. ELKIN.

Digitized by Google

SECRETARY'S REPORT.

YALE UNIVERSITY OBSERVATORY,

NEW HAVEN, CONN., June 25, 1897.

To the Board of Managers:

GENTLEMEN:—I have the honor to report for the year ending with May 31, 1897, as follows:

THE OBSERVATORY BUILDING.

In the construction of the present half of the Observatory building (as planned), the east wall was regarded as a partition from the main halls (upper and lower), and not intended for many years' exposure to the weather. While this wall shows, as yet, no serious inroad of the storms, the light door which has served as the entrance to the building, has offered, each year, less and less resistance to the wind and rain, until it became necessary last winter to add the protection of a winter vestibule.

The stairs to the East Tower were repaired and painted.

The West Tower was painted an olive green on the inside.

The inside of the high fence about the Photographic Observatory was painted red, on account of the reflection of light into the cameras from the white paint first employed.

The outside blinds of the building were repainted. All the painting mentioned in this and in late reports has been done by Mr. Toohey, the acting janitor of the building.

The growth of the library will make it necessary to add a number of book cases during the coming year.

THE OBSERVATORY GROUNDS.

A few ornamental shrubs have been added, at the cost of planting. The large chestnut trees were pruned of a number of dead branches which marred their appearance and drew upon their vitality. One elm tree has been planted on the west side of St. Ronan street, next north of our south line.

Digitized by Google

The wooden coverings over the street gutters at the Prospect street entrances to the Observatory and to the dwellings having completely decayed, six-inch iron pipes were substituted, one and two years ago, and have proved to be more easily cleaned and kept clean, and will call for no further repair.

None of the elms, either within the Observatory grounds, or upon the north lots, or on any of the adjacent sidewalks, were seriously injured by the "Elm-tree Beetle" (*Galerucella luteola*), which caused so much damage in this city and elsewhere during last year and the preceding one. Unable to pay for the spraying with the kerosene emulsion of the large number of trees under our care, we were forced to be content with the method of trapping the larvæ in folds of muslin tied about the trees, where they transformed into pupæ, and were gathered and destroyed every week, the pupa period being ten days. They have now pretty much disappeared through the combined efforts of insect, bird and man.

The contributions to the Library of the Observatory during the year ending with May 31st, 1897, have been as follows:

Albany. New York State Library, 76th Annual Report for the year ending Sept. 30, 1893. 8°. *Albany*, 1894.	The Library.
—— —— 77th—— for the year 1894. *Albany*, 1894.	——
Barcelona. Real Academia de Ciencias y Artes. Historia de la Real Academia. Memoria inaugural del año academico de 1893 á 1894. D. Jose Balari y Jovany. 8°. *Barcelona*, 1895.	The Academy.
—— —— Boletin. 4°. Vol. I, Nos. 1 to 13. *Barcelona*, 1892–96.	——
Berlin. Die Königliche Sternwarte. Bemerkungen zu dem Bericht der Herren Schnauder und Dr. Hecker über die am photographischen Zenithteleskop erhaltenen Resultate. A. Marcuse. 4°. *Berlin*, 1896.	The Observatory.
—— —— Über die photographische Bestimmungsweise der Polhöhe. A. Marcuse. [Abdr. aus den Astr. Nachr., Bde. 141, 142.] 4°. *Kiel*, 1896.	——

Digitized by Google

The Observatory. Berlin. Die Königliche Sternwarte. Ueber die systematischen Fehler der Distanzmessungen mit neuern Heliometern. [Abdr. aus den Astr. Nachr., Bd. 142.] Dr. Fritz Cohn. 4°. *Kiel*, 1896.

The Commission. —— Die Venus-Durchgänge 1874 und 1882. Bericht über die Deutschen Beobachtungen. Im Auftrage der Commission für die Beobachtung des Venus-Durchgangs herausgegeben von A. Auwers. VI^ter Band. 4°. *Berlin*, 1896.

The Academy. Bologna. R. Accademia delle Scienze dell'Istituto. Memorie della Sezione delle Scienze Fisiche e Matematiche. Serie V, Tomo IV. 4°. *Bologna*, 1894.

The Observatory. Bordeaux. L'Observatoire. Annales. Par G. Rayet, Directeur. 4°. Tomes I—VI. *Paris* and *Bordeaux*, 1885–96.

The Academy. Boston. American Academy of Arts and Sciences. Proceedings. Vol. XXXI. 8°. *Boston*, 1896.

—— —— —— Vol. XXXII, Nos. 1–14. *Boston*, 1896–97.

The Exposition Secretaries. Bruxelles. Exposition Internationale en 1897. [Programme of the] Section des Sciences. (Section 5 bis.) 8°. *Bruxelles*, 1896.

The Institute. Bucharest. Institutul Meteorologic. Buletinul Observatiunilor Meteorologice din România. Steffan C. Hepites, Directorul. 4°. Anul. IV, 1895. *Bucharest*, 1896.

—— —— —— Analele. Tomul X, Anul 1894. 4°. *Bucharest*, 1895.

The Publishers. Buffalo. Medical and Surgical Journal. June, 1896–May, 1897. 8°. *Buffalo*, 1896–97.

The Observatory. Cambridge. The Astronomical Observatory of Harvard College. Annals. 4°. (Title page to Vol. XX.) *Cambridge*, 1896.

—— —— —— —— —— Vol. XXVIII, Part I. Spectra of Bright Stars Photographed with the 11-inch Draper Telescope, as a part of the Henry Draper Memorial and discussed by Antonia C. Maury, under the direction of Edward C. Pickering. *Cambridge*, 1897.

Digitized by Google

Cambridge. The Astronomical Observatory of Harvard College. Annals. Vol. XXX, Part IV. Discussion of Cloud Observations. *Cambridge*, 1896.

—— —— —— Vol. XXXVI. Journal of the Zone Observations of Stars between 49° 50′ and 55° 10′ of N. Declination in 1885.0 and observed . . during the years 1875 to 1885, under the direction of Joseph Winlock and Edward C. Pickering, by Wm. A. Rogers. *Waterville, Me.*, 1896.

—— —— —— Vol. XL, Part V, and title to Volume. Observations made at the Blue Hill Meteorological Observatory in the year 1895. Under the direction of A. Lawrence Rotch, A.M. *Cambridge*, 1896.

—— —— —— Vol. XLI, No. IV. Observations of the New England Weather Service in the year 1895. By J. Warren Smith. *Cambridge*, 1896.

—— —— Circulars. 4°.

a. No. 15. The Bruce Photographic Telescope, with "Process" print of Trifid Nebula, etc. (3 Plates.)

b. No. 16. The Spectrum of ζ. Puppis. *Cambridge*, 1897.

—— —— List of Miscellaneous Papers, 1888–1895. 8°. *Cambridge*, 1896.

—— —— List of Miscellaneous Quarto Publications. 4°. *Cambridge*, 1896.

—— —— Fifty-first Annual Report of the Director. 8°. *Cambridge*, 1896.

Cambridge, England. Observatory Syndicate. Annual Report, May 26, 1896. 4°. *Cambridge*, 1896.

Cape of Good Hope. Royal Observatory. Results of Meridian Observations of Stars, made in 1888 and 1889, under the direction of David Gill, LL.D. 4°. *London*, 1895.

—— —— —— In 1890 and 1891. *London*, 1895.

—— —— Report of Her Majesty's Astronomer at the Cape of Good Hope, for the year 1895. 4°. *London*, 1896.

Digitized by Google

The Author. Chandler, S. C. Third Catalogue of Variable Stars. [Astr. Jour. No. 379.] 4°. *Boston*, 1896.

The Society. Chapel Hill. Journal of the Elisha Mitchell Scientific Society. Vol. XII, Second Part, 1895. 8°. *Chapel Hill, N. C.*, 1895.

——— —— —— Vol. XIII, Part First, 1896. *Chapel Hill, N. C.*, 1897.

The Board of Editors. Chicago. The Astrophysical Journal. Vol. III, No. 1. 8°. *Chicago*, 1896.

The Observatory. —— Yerkes Observatory. Bulletin No. 1. 8°. (2 copies.) *Chicago*, 1896.

——— Coimbra. Observações Meteorologicas e Magneticas feitas no Observatorio Meteorologico e Magnetico da Universidade de Coimbra, no Anno de 1894. 4°. *Coimbra*, 1896.

——— —— —— 1895. *Coimbra*, 1896.

J. D. and E. S. Dana. Cordoba. Anales de la Oficina Meteorológica Argentina por su Director, Gaulterio G. Davis. 4°. Tomo X. Climas de Salta, Tacuman, etc. *Buenos Aires*, 1896.

The Author. Dexter, Franklin B. Directory of the Living Graduates of Yale University. 8°. *New Haven.*

The Society. Dorpat. Société Astronomique Russe. Éphémérides des Étoiles pour 1897. W. Döllen. 8°. *St. Petersburg*, 1896.

The Observatory. —— Sternwarte. Aufruf zur Umgestaltung der nautischen Astronomie nebst Anhang, 1896. 4°. *Dorpat*, 1893.

——— Dresden. Observatoire de B. D'Engelhardt. 4°. *Dresden*, 1895.

——— Dunsink. Astronomical Observations and Researches made at the Observatory of Trinity College, Dublin. Seventh Part, Mean Places of 717 Stars, deduced from Observations made with the Meridian Circle at Dunsink, by A. A. Rambaut. 4°. *Dublin*, 1896.

Digitized by Google

Dunér, N. C. On the Periodic Changes of the Variable Star Z Herculis. [Reprint from The Astroph. Jourl., Apl. 1895.] 8°. *Chicago*, 1895. — The Author.

Durban, Natal, S. Africa. Annual Report of the Government Astronomer for the year 1894–95 [also of Government Laboratory]. E. Nevill, Supt. 4°. *Pietermaritzburg*, 1896. — The Observatory.

—— —— for the half-year ending with Dec. 31, 1895. *Pietermaritzburg*, 1896. — ——

Florence. R. Istituto di Studi Superiori Pratici e di Perfezionamento. R. Osservatorio di Arcetri. Pubblicazioni Fasc. 1–4. 8°. *Firenze*, 1896. — ——

—— A. Abetti. Il primo istante della gran scossa di terramoto del 18 maggio 1895 notato in Arcetri. [Estratto del Bollettino della Società Sismologica Italiana, Vol. I, fasc. VII.] 8°. *Firenze*, 1895. — The Author.

—— —— Cometa I, 1896 (Perrine-Lamp). [Estratto dalle Memorie della Società degli Spettroscopisti Italiani, Vol. XXV.] 4°. *Firenze*, 1896. — ——

Geneva. Société des Arts. Rapport sur le Concours pour le réglage des Chronomètres pour l'année 1895. Présenté le 16 Mars 1896. Raoul Gautier, Directeur de l'Observatoire. 8°. *Geneva*, 1896. — The Geneva Observatory.

—— —— Concours international de réglage pour chronomètres de poche de haute precision en 1896. Rapport. 8°. *Geneva*, 1896. — ——

—— Nouvelles moyennes pour les principaux éléments météorologiques de Genève de 1826 a 1895, par Emile Gautier et Raoul Gautier, Directeurs de l'Observatoire. 8°. *Geneva*, 1897. — ——

—— Résumé météorologique de l'annee 1896 pour Genève et le Grand Saint Bernard, per A. Kammerman, Astronome. 8°. *Geneva*, 1897. — ——

Digitized by Google

The Observatory. Georgetown. Georgetown College Observatory. Photographic transits of 161 Stars. 4°. *Washington*, 1896.

The Astronomer Royal. Greenwich. Royal Observatory. Astronomical and Magnetical and Meteorological Observations made in the year 1893, under the direction of W. H. M. Christie. 4°. *London*, 1896.

——— —— —— Reduction of Greenwich Meterological Observations, Part III. Temperature of the air 1841 to 1890. 4°. *London*, 1895.

The Lords Commissioners of the Admiralty. ——— —— Assumed Mean Right Ascensions of Clock Stars with the corrections to the R. A. of the Nautical Almanac for 1897.0. 4°. *London*, 1896.

——— —— —— Nautical Almanac and Astronomical Ephemeris for the year 1900. 8°. *London*, 1896.

——— —— —— Rates of Chronometers on Trial for purchase by the Board of Admiralty. 4°. *London*, 1896.

——— —— —— Rates of Deck Watches on Trial for purchase by the Board of Admiralty. 4°. *London*, 1896.

The Institution. Haarlem. Musée Teyler. Archives, Série II, Vol. V, Parties 1ère et 2ème. 4°. *Haarlem*, 1896.

The Institute. Halifax, Nova Scotia. Nova Scotian Institute of Science. Proceedings and Transactions. 8°. 2d Series. Vol. II, Parts 1 and 2. *Halifax*, 1896.

The Observatory. Hamburg. Die Sternwarte. Bericht, 1895. 8°. [*Hamburg*], 1896.

The College. Havana. Real Colegio de Belen de la Compañia de Jesus. Observaciones Magnéticas y Meteorológicas. Año de 1892. 4°. *Havana*, 1896.

——— —— —— —— Año de 1893. *Havana*, 1897.

Digitized by Google

Helsingfors. [Öfvertryck ur Finska Vet. Soc. Öfversigk. B. XXXIX. 8°.] Redogörelse för fortgången af de Astrofotografiska arbetena å observatoriet i Helsingfors under tiden Juni 1895 till Maj 1896. Anders Donner. *Helsingfors*, 1896. — Helsingfors Observatory.

—— Acta Societatis Scientiarum Fennicae. Tom. XXI, No. 8. Sur le rattachement de clichés astrophotographiques. Anders Donner. 4°. *Helsingfors*, 1896. ——

Hongkong. Observations and Researches made at the Observatory in the year 1895, by W. Doberck, Director. 4°. *Hongkong*, 1896. — The Observatory.

Karlsruhe. Veröffentlichungen der grossherzoglichen Sternwarte, herausgegeben von W. Valentiner. Fünftes Heft. 4°. *Karlsruhe*, 1896. ——

Kasan. [Magnetic and Meteorological Observatory of the Imperial University.] Observations. Année 1895, Sept.–Dec. 8°. *Kasan*, 1895. ——

—— —— —— Année 1896. Janv.–Mars. *Kasan*, 1896. ——

—— [Astronomical Observatory of the Imperial University.] Resultate der Beobachtungen in Kasan betreffend die Veränderlichkeit der Polhöhe. II. Beobachtungsreihe 3 Juli 1893–11 Januar 1895. A. M. Kowalski. 4°. *Kasan*, 1896. ——

Leiden. Rijks Observatorium. Verslag van den Staat der Sterrenwacht te Leiden en van de aldaar volbrachte Waarnemingen, in het Tijdvak van den 18den September 1894 tot den 15den September 1896. 8°. *Leiden*, 1896. ——

Lisbon. Real Observatorio Astronomico de Lisboa (Tapada). Observations Méridiennes de la Planète Mars pendant l'opposition de 1892. 4°. *Lisbonne*, 1895. ——

Digitized by Google

The University. Lund. Universitets Års-skrift. Tom. XXXII. 1896. Kongl. Fysiografiska Sällskapets Handlingar. 4°. *Lund*, 1896.

The Observatory. —— L'Observatoire. Observations des Étoiles de la Zone entre 35° et 40° de déclinaison boréale—Réduites à l'équinoxe moyen de 1875.0 par N. C. Dunér et Folke Engström. Tome I. 4°. *Lund*, 1896.

—— —— Berechnung der Bahn des Kometen 1890, II. Elis Strömgren. 4°. [Sonderabdruck aus Acta Reg. Soc. Phys. Lund, T. VI.] *Lund*, 1896.

—— Lussinpiccolo. Manora Observatory. Thätigkeit im Jahre 1895. [Naturwissen schaftliche Wochenschrift, 31 Mai, 1896.] 4°. *Berlin*, 1896.

—— Madison. Washburn Observatory. Publications. Vol. X, Part 1. Observations of Double Stars, 1892–96. 4°. *Madison*, 1896.

—— —— —— University of Wisconsin. Bulletin. Science Series, Vol. I, No. 3. Studies in Spherical and Practical Astronomy. George C. Comstock, Director of the Washburn Observatory. 8°. *Madison*, 1895.

The Society. Manchester. Literary and Philosophical Society. Memoirs and Proceedings. Fourth Series. Vol. X. (Whole No. XL.) No. 3, and List of Members, Appendices, etc. 8°. *Manchester*, 1896.

—— —— —— —— Vol. XXLI, Parts 1 and 2. *Manchester*, 1896.

The Author. Mansill, Richard. Almanac for the year 1897. 8°. *Rock Island*, 1897.

—— Marth, A. [Reprints from Mo. Not., R. A. S. 8°. Vol. LVI, No. 10.]

a. Ephemeris for Physical Observations of Jupiter, 1896–97.

b. Data for Computing the Positions of the Satellites of Jupiter, 1896–97.

London, 1896.

Digitized by Google

Marth, A. Ephemeris of the Satellites of Mars, 1896–97. [Ibid, No. 8.] *London*, 1896.	The Author.
—— —— Ephemeris for Physical Observations of Mars, 1896–97. [Ibid. No. 7.] *London*, 1896.	——
—— —— Ephemeris for Physical Observations of the Moon, 1897, January to August. [Vol. LVII, No. 2.] *London*, 1897.	——
Milan, R. Osservatorio Astronomico di Brera. [Estratto dai "Rendiconti" del R. Ist. Lomb. Vol. XXIX, 1896.] Riassunto delle Osservazioni Meteorologiche eseguite nell' anno 1895. E. Pini. 8°. *Milan*, 1896.	The Observatory.
—— Mont Blanc. Observatoire Météorologique. Annales. Tome II. J. Vallot. 4°. *Paris*, 1896.	——
Montévidéo. (Repub. O. de Uruguay.) Loi du Rayonnement Thermique Solaire, et Tables du Soleil. Charles Honoré. 8°. [2 copies.] *Montévidéo*, 1896.	The Author.
Mount Hamilton. Lick Observatory. The Observatory Atlas of the Moon. Folio. Plates 1 to 5. *Mount Hamilton*, 1896–97.	The Observatory.
New York. Columbia University Observatory. Contributions. [Reprints from the Annals of the New York Academy of Sciences. Vol. IX.] 8°. No. 10. On the Reduction of Stellar Photographs. No. 11. On the Permanence of the Rutherfurd Photographic Plates. By Harold Jacoby. *New York*, 1897.	——
—— The Jewelers' Circular and Horological Review. 4°. Vol. XXXII, Nos. 18 to end. *New York*, 1896.	The Publishers.
—— —— Vol. XXXIII. *New York*, 1896–97.	——
—— —— Vol. XXXIV, Nos. 1–17. *New York*, 1897.	——
Oxford. Radcliffe Observatory. Results of Astronomical and Meteorological Observations in the years 1888–89. Under Edward James Stone. Vol. XLVI. 8°. *Oxford*, 1896.	The Observatory.

Digitized by Google

The Observatory. Oxford. University Observatory. Report of the Visitors of the University Observatory for 1895–96. 8°. *Oxford*, 1896.

—— —— —— Some notes on the use and adjustment of the Cœlostat, by H. H. Turner. [Reprint from Mo. Not. R. A. S. Vol. LVI, No. 8.] 8°. *London*, 1896.

The Academy. Padua. R. Accademia di Scienze, Lettere ed Arti. Atti e Memorie. 8°. Anno CCXCVI (1894–95), Nuova Serie. Vol. XI. *Padova*, 1895.

—— —— —— —— Anno CCXCVII, (1895–96.) Vol. XII. *Padova*, 1896.

—— —— R. Osservatorio. L'Effetto della flessione del pendolo sul tempo della sua oscillazione. G. Lorinzoni. *Venezia*, 1896.

—— —— —— [Estratto dagli Atti del R. Ist. Veneto di Scienze, Lettere ed Arti., Serie VII. 8°. Tome V, 1893–94.] Seguito e fine delle Osservazioni Astronomiche fatte nel 1893. App. Sull' Orbita del pianete 1893 A = (354). 8°. A. Abetti. *Venezia*, 1894.

—— —— —— [—— Tomo VI, 1894–95.] Osservazioni di pianeti e comete, nel 1894. G. Ciscato. *Venezia*, 1895.

—— —— —— [—— Tomo VII, 1895–96.] Equazioni de Conditione per le Occultazioni osservate a Padova nel 1894 e nel 1895. Antonio Antoniazzi. *Venezia*, 1896.

—— —— —— [——] Osservazioni di pianeti e comete nel 1895. G. Ciscato. *Venezia*, 1896.

Bureau des Longitudes. Paris. Bureau des Longitudes. Connaissance des Temps—pour l'an 1898. 8°. *Paris*, 1895.

—— —— —— —— Extrait à l'usage des Écoles d'Hydrographie et des Marins du Commerce, pour l'an 1897. 8°. *Paris*, 1895.

—— —— —— —— —— pour l'an 1898. 8°. *Paris*, 1896.

—— —— —— Annuaire pour l'an 1896. 12°. *Paris*, [1895.]

Digitized by Google

Paris. Bureau des Longitudes. Annuaire pour l'an 1897. 12°. *Paris*, [1896.] — Bureau des Longitudes.

—— —— Ephémérides des étoiles de culmination lunaire et de longitude pour 1897 par M. M. Lœwy. 4°. *Paris*, 1896. ——

—— —— Enquètes et Documents rélatifs à l'Enseignement Supérieur. LIX. Rapport sur les Observatoires Astronomiques de Province Année 1894. 8°. *Paris*, 1895. ——

—— —— L'Observatoire Municipal de Montsouris. Annuaire pour l'année 1897. 12°. *Paris*, [1896.] — The Observatory.

Pola. Sternwarte des hydrographischen Amtes der K. u. K. Kriegsmarine. Jahresbericht der Meteorologischen und Magnetischen Beobachtungen. 1895. 4°. *Vienna*, 1896. ——

—— —— Meteorologische Termin-Beobachtungen in Pola und Sebenico. April 1896–März 1897. 4°. *Vienna*, 1896–97. ——

Potsdam. Internationale Erdmessung. Bericht über den gegenwärtigen Stand der Erforschung der Breitenvariation. 4°. *Lausanne*, 1896. — The Bureau.

—— —— Bericht über die am photographischen und am visuellen Zenitteleskop erhaltenen Resultate. 4°. *Potsdam*, 1896. ——

—— —— Vergleichung der optischen und der photographischen Beobachtungsmethode zur Bestimmung der Breitenvariation. 4°. *Potsdam*, 1896. ——

—— —— Ueber die Wahl der Stationen für den internationalen Polhöhendienst. 4°. *Potsdam*, 1896. ——

—— —— Circular vom 20, Juni, 1896. 4°. *Potsdam*, 1896. ——

Prague. K. K. Sternwarte. Magnetische und Meteorologische Beobachtungen im Jahre 1895. 56 Jahrgang. 4°. *Prag*, 1896. — The Observatory.

Digitized by Google

The Observatory. Prague. K. K. Sternwarte. Astronomische Beobachtungen in dem Jahren 1888, 1889, 1890 und 1891. Provisorische Resultate aus den fortlaufenden Polhöhen-Messungen vom 26 Februar 1889 bis 29 Mai 1892. 4°. *Prag*, 1897.

The Society. —— Königl. böhmische Gesellschaft der Wissenschaften. Jahresbericht für das Jahr 1895. 8°. *Prag*, 1896.

—— —— —— Sitzungsberichte der mathematisch-naturwissenchaftlichen Classe. Jahrgang 1895, I und II. 8°. *Prag*, 1896.

The Observatory. Pulcova. Observatoire Central Nicolas. Publications sous la Direction de O. Backlund. Série II, Vol. 11. Observations faites au Cercle Vertical. M. Nyrén. *St. Petersburg*, 1896.

—— Quito. Observatorio Astronomico. Boletin. Num. 5–12, y Resumen por el Año 1895–96. 8°. *Quito*, 1896.

—— Richmond, England. Kew Observatory. Report of the Kew Observatory Committee of the Royal Society, for the Year ending December 31, 1896. 8°. *London*, 1897.

—— —— —— Description of the Kew Observatory. 8°. *London*, 1897.

—— —— —— Observations on Atmospheric Electricity at the Kew Observatory. 8°. [From the Proceedings of the Royal Society, Vol. 60.] *London*, 1896.

The Author. Rome. Reale Accademia dei Lincei. (Anno CCXCIII 1895–96.) Osservazioni astronomiche e fisiche sull'asse de rotazione e sulla topografia del pianeta Marte. Memoria quarta del Socio G. V. Schiaparelli, 1883–84. 4°. *Roma*, 1896.

The Observatory. Rugby. The Temple Observatory. Report for the year 1895, and List of Double Stars. 8°. *Rugby*, 1896.

The Academy. St. Louis. Academy of Science. Transactions. 8°. Vol. VII, Nos. 6–14. *St. Louis*, 1896–97.

Digitized by Google

St. Petersburg. Izvestia Russkago Astronomitscheskago Obschtschestva, 3–8. 8°. *St. Petersburg*, 1896. — The Society.

—— Académie Impériale des Sciences. [Bulletin T. V., No. 5, Dec. 1896.] Sur quelques systèmes de météores. Th. Brédikhine. 8°. *St. Petersburg*, 1896. — The Author.

San Fernando. Instituto y Observatorio de Marina. Almanaque Náutico para el año 1898. 8°. *Madrid*, 1896. — The Institute and Observatory.

San Francisco. Astronomical Society of the Pacific. Publications. 8°. Vol. VIII, Nos. 50–53. *San Francisco*, 1896. — The Society.

—— —— —— Vol. IX, Nos. 54, 55. *San Francisco*, 1897. — ——

San Salvador. Observatorio Astronómico y Meteorológico. Observaciones Meteorológicas durante el Mes de Enero 1897. *San Salvador*, 1897. — The Observatory.

Schiaparelli, Giovanni. Rubra Canicula. Considerazioni sulla mutazione di colore che si dice avvenuta in Sirio. [Estratto dagli Atti dell' I. R. Accademia di Scienze, Lettere ed Arti degli Agioti; Serie III, Vol. II, Fasc. II. *Rovereto*, 1896. — The Author.

Schur, W. Ueber die Abplattung des Planeten Mars. [Aus den Nachrichten der K. Gesellschaft der Wissenschaften zu Göttingen; Math–Phys. Klasse, 1897, Heft 1.] 8°. *Göttingen*, 1897. — ——

See, Dr. T. J. J. Lowell Observatory, Mexico. Researches on the Evolution of the Stellar Systems, Vol. I. On the Universality of the Law of Gravitation and on the Orbits and general characteristics of Binary Stars. 4°. *Lynn*, 1896. — ——

Shanghai. Meteorological Society. Fourth Annual Report; for the Year 1895. 8°. *Zi-Ka-wei*, 1896. — The Society.

Digitized by Google

The Observatory. Strassburg. Kaiserliche Universitäts-Sternwarte. Annalen. E. Becker, Director. Band I. 4°. *Carlsruhe*, 1896.

The Promoters. —— Propositions relatives à l'organization d'un système international de stations seismiques. 8°. *Strassburg*, 1895.

The Observatory. Sydney, N. S. W. Government Observatory. (No. 130.) Results of Rain, River, and Evaporation Observations made in New South Wales during 1894. H. C. Russell, Government Astronomer. 8°. *Sidney*, 1895.

—— —— —— (No. 126.) Recent Measures of Double Stars, made at Sidney. By H. C. Russell, Government Astronomer [Abdruck aus den Astr. Nachr. Bd. 138.] 4°. *Kiel*, 1895.

—— —— —— (No. 120.) The Meteor of June 27, 1894. H. C. Russell. [Roy. Soc. N. S. W., Sept. 5, 1894.] 8°. *Sydney*, 1894.

—— —— —— (No. 121.) A Map showing the average monthly rainfall in New South Wales. H. C. Russell. [Roy. Soc. N. S. W., Nov. 7, 1894.] 8°. *Sydney*, 1894.

—— —— —— (No. 129.) Icebergs in the Southern Ocean. H. C. Russell. [Roy. Soc. N. S. W., Sept. 4, 1895.] [*Sydney*], 1895.

—— —— —— (No. 131.) Design for a Photographic Transit Circle. [Reprint from Australasian Assoc. for the Adv. of Sci., Brisbane.] H. C. Russell, Gov. Astr. —— 1895.

—— Tacubaya. Observatorio Astronómico Nacional. Boletin. Tomo I. Núm. 25. 4°. *Mexico*, 1896.

—— —— —— Anuario para el año de 1897. Año XVII. 8°. *Mexico*, 1896.

The Director. Toronto. Meteorological Service of the Dominion of Canada. Monthly Weather Review, Nov. 1895–Oct., 1896. 4°. *Toronto*, 1896–97.

—— —— —— —— Jan.–Mch., 1897. *Toronto*, 1897.

—— —— —— General Meteorological Register for the year 1896. 8°. *Toronto*, [1897.]

Digitized by Google

Toronto. The Canadian Institute. Transactions. 1891–92. Vol. V, Part I. 8°. *Toronto*, 1896. — The Institute.

—— —— Proceedings. New Series. Vol. I, Part I. 8°. *Toronto*, 1897. ——

Updegraff, Milton. Flexure of Telescopes. [Extract from Trans. St. Louis Acad. of Sci. Vol. VII, No. 11.] 8°. *St. Louis*, 1896. — The Author.

Upsala. Königl. Gesellschaft. der Wissenschaften. Formeln und Tafeln zur gruppenweise Berechnung der allgemeinen Störungen benachbarter Planeten. Karl Bohlin. 4°. *Upsala*, 1896. — Upsala Observatory.

—— [Theses presented to the Upsala University.] 4°. Gustav Cassel. Kritiska studier öfver teorin för de automorfa funktionerna jämte deras användning för integration of linjära differentialekvationer. *Upsala*, 1894. — The Royal University Library.

—— —— N. V. E. Nordenmark. Sur le moyen mouvement dans l'anneau des Asteroides. *Upsala*, 1894. ——

—— —— Frans de Brun. Bidrag till Weierstrass' teori för algebraiska funktioner. *Upsala*, 1895. ——

—— —— Eric Hallgren. Om beräkningen af Abelska integralers omvänding. 8°. *Göteborg*, 1894. ——

Vienna. Œsterreichische Gradmessungs-Commission. Verhandlungen. Protokolle über die am 19. Juni, 1896, abgehaltene Sitzung. 8°. *Vienna*, 1896. — The Commission.

—— —— Astronomische Arbeiten [Publicationen für die Internationale Erdmessung.] VII. Band. Längenbestimmungen. 4°. *Vienna*, 1895. ——

—— —— —— VIII. Band. Breiten-Azimut-und Winkelbestimmungen. 4°. *Vienna*, 1896. ——

—— Die v. Kuffner'sche Sternwarte (Ottakring). Publicationen. Dr. Leo de Ball. IV. Band. 4°. *Vienna*, 1896. — The Observatory.

Digitized by Google

Office of the Am. Eph. and Naut. Almanac. Washington. American Ephemeris and Nautical Almanac for the year 1899. 8°. *Washington*, 1896.

The Society. —— Philosophical Society. Bulletin, Vol. XII. 1892–1894. 8°. *Washington*, 1895.

The Institution. —— The Smithsonian Institution. Mountain Observatories in America and Europe. Edward S. Holden. 8°. *Washington*, 1896.

U. S. Coast and Geod. Survey. —— U. S. Coast and Geodetic Survey. Report of the Superintendent for the year ending with June, 1894, Pt. II. 4°. *Washington*, 1895.

—— —— —— —— 1895, Pts 1 and 2. *Washington*, 1896.

—— —— —— Bulletin No. 35. 8° *Washington*, 1896.

The Observatory. —— U. S. Naval Observatory. Astronomical, Magnetic and Meteorological Observations made during the year 1890. 4°. *Washington*, 1895.

—— —— —— —— Appendix I. A Catalogue of 16748 Southern Stars. Deduced . . from the Zone Observations made at Santiago di Chile . . during the years 1849–52. J. M. Gilliss. 4°. *Washington*, 1895.

—— —— —— —— 1894. — Appendix I. Magnetic Observations, 1894. 4°. *Washington*, 1895.

—— —— —— Meteorological Observations and Results, 1890. 4°. *Washington*, 1894.

Branch Office, New York. —— U. S. Navy. Hydrographic Office. Pilot Charts of the North Atlantic Ocean, June, 1885–May, 1897. Folio. *Washington*, 1895–97.

The Observatory. Windsor, N. S. W. Mr. Tebbutt's Observatory. Report for the year 1896. John Tebutt. 8°. *Sydney*, 1897.

—— Xalapa. Observatorio Meteorológico Central del Estado de Veracruz Llave. Boletin Mensual. Marzo, 1896–Enero, 1897. 4°. *Xalapa*, 1896–97.

—— Zi-ka-wei. L'Observatoire Magnétique et Météorologique. Bulletin Mensuel. Tome XXI. Année 1895. 4°. *Shanghai*, 1897.

Digitized by Google

Zi-ka-wei. L'Observatoire Magnétique et Météorologique. Supplément aux Bulletins Mensuels de 1873 à 1892. 4°. *Shanghai*, 1897.	The Observatory.
—— —— The "Iltis" Typhoon, July 22–25, 1896. Rev. Louis Froc, S. J. *Zi-ka-wei*, 1896.	——
Zurich. Astronomische Mittheilungen gegründet von Dr. Rudolph Wolf. 8°. Vol. VIII. No. LXXXVII. Herausgegeben von A. Wolfer. *Zürich*, 1895.	——
—— Sternwarte. Zur Bestimmung der Rotationzeit der Sonne. A. Wolfer. 8°. *Zürich*, 1896.	——

In addition to the foregoing there have been placed upon the Library table, shortly after publication, as loans, the following periodicals:—

By Dr. Elkin: "Astronomische Nachrichten;" "The Astronomical Journal;" "Vierteljahrsschrift der Astronomischen Gesellschaft;" "Monthly Notices of the Royal Astronomical Society," "Science" and "Nature."

Also: "American Journal of Science and Arts."

THE THERMOMETRIC BUREAU.

The number of thermometers received for verification, and proportion rejected, remain about the same as last year. Mr. Peck has continued in charge of this department.

Very respectfully submitted,

ROBERT BROWN,

Secretary of the Observatory.

Digitized by Google

Digitized by Google

Sci 772.5

Report for the Year 1897–98, presented by the Board of Managers of the Observatory of Yale University to the President and Fellows.

Digitized by Google

HARVARD COLLEGE LIBRARY
JUL 10 1899
CAMBRIDGE, MASS.

OBSERVATORY OF YALE UNIVERSITY.

BOARD OF MANAGERS.

Rev. TIMOTHY DWIGHT, D.D., LL.D., *President.*
ASAPH HALL, PH.D., LL.D.
WILLIAM W. FARNAM, M.A.
THOMAS G. BENNETT, PH.B.
Professor CHARLES S. HASTINGS, PH.D.
WILLIAM L. ELKIN, PH.D.

OFFICERS.

WILLIAM L. ELKIN, PH.D., *Director.*
ROBERT BROWN, M.A., *Secretary.*
FREDERICK L. CHASE, PH.D., *Assistant Astronomer.*

Digitized by Google

REPORT.

YALE UNIVERSITY, June 26, 1899.

To the President and Fellows of Yale University:

GENTLEMEN—The Board of Managers herewith transmit the Reports of Dr. Elkin, Director, and of Mr. Brown, Secretary of the Observatory.

We have to acknowledge a grant of one thousand dollars from the J. Lawrence Smith Fund of the National Academy of Sciences, for which we beg to render our thanks.

Respectfully submitted by

THE BOARD OF MANAGERS.

Digitized by Google

REPORT OF DR. ELKIN.

YALE UNIVERSITY, June 12, 1899.

To the Board of Managers of the Observatory:

GENTLEMEN:—The heliometer has been employed during the past year in securing the final measures for the parallax series on stars of large proper motion, which has thus been brought to a close. The reduction of the results are also approaching completion and will probably be available in the near future. Dr. Chase has also continued the investigation on the refraction of highly colored red stars in order to strengthen the results already obtained. These appear to show that systematic error from this source is hardly to be feared with the heliometer, and hence further discussion of our parallax results to be scarcely requisite.

With the aid of the grant from the J. Lawrence Smith fund of the National Academy, a second station for photographic observation of meteors was put up in Hamden, about two miles in a northerly direction from the Observatory, on the grounds of the late O. F. Treadwell, Esq. (Yale Coll. 1862). The apparatus used was a simple form of equatorial mounting without clockwork, and carried four cameras with portrait lenses of about five inches aperture. Dr. Chase took charge of this station, and it was first put into operation at the August meteor period of last year. Owing to moonlight and the generally hazy and damp atmosphere, only one meteor trail was secured, which was, however, not a Perseid, while at the Observatory station only this meteor and one other, a Perseid, were recorded.

At the epoch of the Leonid shower, which is now near its maximum, watch was kept throughout the nights of Nov. 12 to 16, and complete records obtained on the two nights, Nov. 14 and 15. On these in all 16 meteor trails were impressed on the plates at the two stations, 10 at the Observatory, and 6 at Hamden, 8 of which were Leonids. Four meteors were recorded at both stations, but unfortunately only one of these

Digitized by Google

was a Leonid. The results of the discussion of the Leonid trails (published in the Astrophysical Journal) show the close accordance and consequent high value of the photographic records. An interesting by-product of the work was the discovery, on examining the plates on Nov. 21, of a faint comet by Dr. Chase, who subsequently followed it with the Grubb equatorial until Dec. 15.

The Geminid shower was quite pronounced on Dec. 11, and two meteors from this radiant were secured at both stations, besides a fifth trail at the Observatory. Two other sporadic meteors were also recorded at both stations at this epoch, but the Orionid, Andromedid, Quadrantid and Lyrid showers were unproductive this year, though carefully watched for. In this photographic work Mr. M. F. Smith has rendered efficient service as well as in the subsequent reductions and computations relating to the same.

The time service has been under the charge of Dr. Chase excepting a portion of last year, when it was carried on by Mr. Smith. During a part of the year Dr. Palmer and Miss Newton have been engaged in computing for the Observatory.

Respectfully,

W. L. ELKIN.

Digitized by Google

SECRETARY'S REPORT.

YALE UNIVERSITY OBSERVATORY,
NEW HAVEN, CONN., June 17, 1899.

To the Board of Managers of the Yale Observatory:

GENTLEMEN:—I have the honor to report for the year ending with May 31, 1899, as follows:

THE OBSERVATORY BUILDINGS.

The iron clamps holding together the pieced chimney caps were found almost rusted away, and were replaced with more substantial ones, and these bedded in cement. The chimneys and the east gable were pointed up with cement where the original mortar was reduced to little better than sand. The tin roof was repaired on the northeast corner where it had been loosened and partly torn away by high winds. Such painting was done as seemed neeessary to preserve the woodwork and the tin roof from the effects of the weather. The library shelving has been further postponed, at the expense of increased crowding and disarrangement. The water supply, while improved, cannot yet be depended upon at the hours of the day when it is most necessary for photographic purposes.

THE LIBRARY.

Among the more valuable additions to the Library should be mentioned the approximate completion of our set of the "Memoirs" and "Monthly Notices" of the Royal Astronomical Society, mainly by the gift of Dr. Elkin.

Digitized by Google

ADDITIONS TO LIBRARY.

The contributions to the Library of the Observatory during the year ending with May 31st, 1899, have been as follows:

Adelaide. Meteorological Observations made at the Adelaide Observatory and at other places in South Australia during the years 1876 and 1877. 4°. *Adelaide*, 1878.	The Observatory.
—— —— during the year 1880. *Adelaide*, 1882.	——
—— —— —— 1881. *Adelaide*, 1884.	——
—— —— —— 1882. *Adelaide*, 1885.	——
—— —— —— 1884 and 1885. *Adelaide*, 1893.	——
—— —— —— 1886 and 1887. *Adelaide*, 1893.	——
—— —— —— 1888. *Adelaide*, 1890.	——
—— —— —— 1889. *Adelaide*, 1891.	——
—— —— —— 1890. *Adelaide*, 1892.	——
—— —— —— 1891. *Adelaide*, 1894.	——
—— —— —— 1892. *Adelaide*, 1894.	——
—— —— —— 1893. *Adelaide*, 1896.	——
—— —— —— 1895. *Adelaide*, 1898.	——
Barcelona. Real Academia de Ciencias y Artes. Nómina del Personal Académico. Año Académico 1898 á 1899. 16mo. *Barcelona*, 1898.	The Academy.
—— —— Sobre la Rotacion del Sol. Eduardo Fontséré y Riba. 4°. *Barcelona*, 1898.	The Author.
—— —— Boletin. 4°. Vol. I, Nos. 18 to 20. *Barcelona*, 1897–8.	The Academy.
Basel. Naturforschende Gesellschaft. Verhandlungen. Band XII, Heft 1. 8°. *Basel*, 1898.	The Society.
Berlin. Die Königliche Sternwarte. Beobachtungs-Ergebnisse, Heft No. 8. Resultate aus Beobachtungen von 379 Anhaltsternen und 1640 durch Anschluss bestimmten Sternen angestellt in den Jahren, 1892–97. 4°. Dr. H. Battermann. *Berlin*, 1899.	The Observatory.
—— Die Venus-Durchgänge 1874 und 1882. Bericht über die Deutschen Beobachtungen. Im Auftrage der Commission für die Beobachtung des Venus-Durchgangs herausgegeben von A. Auwers. I^{ter} Band. 4°. *Berlin*, 1898.	The Commission.

Digitized by Google

The Academy. Bologna. R. Accademia delle Scienze dell'Istituto. Memorie della Sezione delle Scienze Fisiche e Matematiche. Serie V, Tomo V. 4°. *Bologna*, 1896.

The Observatory. Bonn. Die Königliche Sternwarte. Veröffentlichungen. No. 3. Bestimmung der Deklinationen von 487 Sternen und der Polhöhe der Bonner Sternwarte. Carl Wilh. Wirtz. 4°. *Bonn*, 1898.

—— —— —— Untersuchungen über neue Sterne mit Eigenbewegungen. Dr. F. W. A. Argelander. 4°. *Bonn*, 1875.

—— —— —— Nachgelassene Beobachtungen veränderlicher Sterne. F. W. A. Argelander. 4°. *Bonn*, 1898.

—— Bordeaux. L'Observatoire. Annales. Par G. Rayet, Directeur. 4°. Tome VIII. *Paris* and *Bordeaux*, 1898.

The Academy. Boston. American Academy of Arts and Sciences. Proceedings. Vol. XXXIII, Nos. 18–27. 8°. *Boston*, 1898.

—— —— —— Vol. XXXIV, Nos. 1–20. *Boston*, 1898–99.

The Institute. Bucharest. Institutul Meteorologic. Buletinul Observatiunilor Meteorologice din România. Steffan C. Hepites, Directorul. 4°. Anul. VI, 1897. *Bucuresci*, 1898.

—— —— —— Analele. Tomul XII, Anul 1896. 4°. *Bucuresci*, 1898.

The Publishers. Buffalo. Medical and Surgical Journal. July, 1898–June, 1899. 8°. *Buffalo*, 1898–99.

The Observatory. Cambridge. The Astronomical Observatory of Harvard College. Annals. 4°. Vol. XXXIX, Part I. Peruvian Meteorology, 1888–1890. Solon J. Bailey. *Cambridge*, 1899.

—— —— —— —— Vol. XLI, No. V. The Meteoric Shower of Nov. 13, 1897. Wm. H. Pickering *Cambridge*, 1898.

—— —— —— Fifty-third Annual Report of the Director. 8°. *Cambridge*, 1898.

Digitized by Google

Cambridge. Harvard Astrophysical Conference, August, 1898. M. B. Snyder. 8°. *Lancaster, Pa.*, 1898.	The Author.
Cambridge, England. Observatory Syndicate. Annual Report, May 28, 1898. 4°. *Cambridge*, 1898.	The Observatory.
—— The Observatory. Astronomical Observations. 4°. Vol. XXIII (1872–75.) *Cambridge*, 1898.	——
Cape of Good Hope. Royal Observatory. Report of H. M. Astronomer at the Cape of Good Hope to the Secretary of the Admiralty, for the year 1897. 4°. *London*, 1898.	——
—— —— Independent Day-Numbers for the year 1898. 8°. *London*, 1897.	——
—— —— —— for the years 1899 and 1900. *London*, 1898.	——
—— —— Results of Meridian Observations of Stars, made in the years 1892 to 1895, under the direction of David Gill, LL.D. 4°. *London*, [——].	——
—— —— Annals. Vol. I, Part I. Observations of Comets, 1880–1894. *London*, 1898.	——
—— —— —— Vol. IV. Cape Photographic Durchmusterung, Vol. II. Zones —38° to —52°. [*London*, 1896.]	——
Chapel Hill. Journal of the Elisha Mitchell Scientific Society. Vol. XIV, Part Second, 1897. 8°. *Chapel Hill, N. C.*, 1897.	The Society.
—— —— Vol. XV, Part First, 1898. *Chapel Hill, N. C.*, 1898.	——
Chicago. The Earth Measured. [Ratio of the Earth's Axes] and Related Quantities for Earth, Sun and Moon, with Comprehensive Table. By a Member of the Chicago Astronomical Society. 8°. *Chicago*, 1898–99.	The Chicago Astr. Soc.
Christiania. Norwegisches Meteorologisches Institut. Jahrbuch für 1891. 4°. *Christiania*, 1893.	The Royal Norw. Univ.
—— —— —— 1892. 4°. *Christiania*, 1894.	——
—— —— —— 1893. 4°. *Christiania*, 1895.	——

Digitized by Google

The Royal Norw. Univ. — Christiania. Norwegisches Meteorologisches Institut. Jahrbuch für 1894. 4°. *Christiania*, 1896.

—— —— —— —— 1895. 4°. *Christiania*, 1896.

—— —— —— —— 1896. 4°. *Christiania*, 1897.

—— —— —— —— 1897. 4°. *Christiania*, 1898.

The Observatory. — Cincinnati. The Observatory. Publications. No. 3. Micrometrical Measurements of Double Stars, 1875–76. 8°. *Cincinnati*, 1877.

—— —— —— —— No. 5. —— 1878–79. 8°. *Cincinnati*, 1879.

—— —— —— —— No. 6. —— 1879–80. 8°. *Cincinnati*, 1882.

—— —— —— —— No. 14. Catalogue of 2030 Stars for the Epoch 1895, by Jermain G. Porter. 4°. *Cincinnati*, 1898.

—— Coimbra. Observações Meteorologicas e Magneticas feitas no Observatorio Meteorologico e Magnetico da Universidade de Coimbra, no Anno de 1897. 4°. *Coimbra*, 1898.

The Office. — Cordoba. Anales de la Oficina Meteorológica Argentina por su Director, Gaulterio G. Davis. 4°. Tomo XII. Climas de Asuncion, del Paraguay y Rosario de Santa Fé. *Buenos Aires*, 1898.

The Society. — Dorpat. Société Astronomique Russe. Éphémérides des Étoiles pour 1898. W. Döllen. 8°. *St. Peterburg*, 1897.

—— —— 1899. *St. Peterburg*, 1898.

The Observatory. — Dunsink. Astronomical Observations and Researches made at the Observatory of Trinity College, Dublin. Eighth Part. Mean Places of 1101 Stars, deduced from Observations made with the Meridian Circle at Dunsink, by A. A. Rambaut. 4°. *Dublin*, 1899.

—— Durban, Natal, S Africa. Annual Report of the Government Astronomer for the year 1897. E. Nevill, Supt. 4°. *Pietermaritzburg*, 1898.

—— Edinburgh. Royal Observatory Circulars. Nos. 43–53. 8°. *Edinburgh*, 1894–98.

Digitized by Google

Florence. R. Istituto di Studi Superiori Pratici e di Perfezionamento. R. Osservatorio di Arcetri. Pubblicazioni. 8°. Fasc. 7. Il Piccolo Meridiano di Arcetri. *Firenze*, 1898.	The Observatory.
—— —— —— Fasc. 8. Posizioni de 21 Stelle fra la 5ª e 7ª Grandezza. *Firenze*, 1898.	——
—— —— —— Fasc. 9. Osservazioni Astronomiche fatte all' Equatoriale di Arcetri nel 1897. *Firenze*, 1898.	——
Göttingen. Die Königliche Sternwarte. Astronomische Mittheilungen. 5ter Theil. Ableitung relativer Oerter des Mondes gegen die Sonne. W. Schur. 4°. *Berlin*, 1898.	——
Greenwich. Royal Observatory. Astronomical and Magnetical and Meteorological Observations made in the year 1895, under the direction of W. H. M. Cnristie. 4°. *London*, 1897.	The Astronomer Royal.
—— —— —— 1896. *London*, 1898.	——
—— —— Assumed Mean Right Ascensions of Clock Stars with the corrections to the R. A. of the Nautical Almanac for 1899.0. 4°. *London*, 1898.	The Lords Commissioners of the Admiralty.
—— —— Nautical Almanac and Astronomical Ephemeris for the year 1902. 8°. *London*, 1899.	——
Haarlem. Musée Teyler. Archives, Série II. Vol. VI, 1ère Partie. 4°. *Haarlem*, 1898.	The Institution.
—— —— —— 2ème Partie. *Haarlem*, 1898.	——
Halifax, Nova Scotia. Nova Scotian Institute of Science. Proceedings and Transactions. 8°. Vol. IX [2d Series, Vol. II], Part 4. *Halifax*, 1898.	The Institute.
Helsingfors. Finska Vetenskaps Societet. Öfversigt af Förhandlingar. XXXIX, 1896–1897. 8°. *Helsingfors*, 1897.	The Society.
—— Acta Societatis Scientiarum Fennicae. Tom. XXII. 4°. *Helsingfors*, 1897.	——
—— —— Tom. XXIII. *Helsingfors*, 1897.	——
Hongkong. Observations and Researches made at the Observatory in the year 1897 by W. Doberck, Director. 4°. *Hongkong*, 1898.	The Observatory.

Digitized by Google

The Observatory. Hyde Park, Mass. Blue Hill Meteorological Observatory. Bulletins Nos. 1 and 3. 4°. ———, 1899.

——— Kasan. [Astronomical Observatory of the Imperial University.] Publications. 4°. No. VII. Observations des étoiles de la zone entre 75° et 80° de déclinaison boréale, under the direction of D. Doubiago. Tome III. *Kasan*, 1897.

——— ——— ——— No. VIII. [Latitude variations, 1892–1893.] M. A. Gratschew. *Kasan*, 1897.

——— ——— ——— No. IX. [Geodetic determinations.] A. B. Krasnow. *Kasan*, 1898.

——— ——— ——— No. X. A. B. Krasnow. *Kasan*, 1898.

——— ——— [Report]. 8°. 1895. *Kasan*, 1896.

——— ——— ——— 1896. *Kasan*, 1897.

——— ——— ——— 1897. *Kasan*, 1898.

——— Leiden. Annalen der Sternwarte. 4°. VII^ter Band. *Haag*, 1897.

Wm. L. Elkin and R. Brown. London. Royal Astronomical Society. Memoirs. 4°. Vols. 27 to 47, 48, Part 2, and 49. [Vols. 28–35 include Monthly Notices, Vols. 19–26.] *London*, 1859–1890.

Dr. Wm. L. Elkin. ——— ——— Vols. 50 and 51. *London*.

NOTE.—With the Volumes received from Professor Loomis' bequest, our set of this serial is now complete,

Dr. Wm. L. Elkin and R. Brown. ——— ——— Monthly Notices. 8°. [Vols. XIX–XXVI, included, as above, in Memoirs Vols. XXVIII–XXXV.] Vols. XXVII (lacking No. 7), XLIX, No. 9, L–LII. *London*, [v. d.]

Dr. Wm. L. Elkin. ——— ——— ——— Vols. LIII–LVIII. *London*, 1892–1898.

The Society. ——— ——— ——— Vol. LIX, Nos. 1–7. *London*, 1898–99.

[NOTE.—With the Volumes received from Professor Loomis' bequest, our set of this serial lacks Vol. III, Nos. 1–12, Vol. IV, Vol. V, Nos. 1–6 and 20–24 and Vol. XXVII, No. 7.]

Digitized by Google

London. Royal Astronomical Society. Monthly Notices. 8°. Vol. LIX, No. 1. Approximate Ephemeris of the part of the Leonid Swarm through which the Earth passed in 1866. G. Johnstone Stoney. *London*, 1898. — The Author.

—— Royal Society. [Phil. Trans. Series A. Vol. 191, pp. 441–499. 4°.] Experiments on Aneroid Barometers at Kew Observatory, and their Discussion. C. Chree. *London*, 1898. — Kew Observatory.

Louvain. L'Université Catholique. Annuaire pour l'an 1899. 63me Année. 12°. *Louvain*, [1898.] — The University.

Lund. Universitets Års-skrift. Tom. XXXIV. 1898. Kongl. Fysiografiska Sällskapets Handlingar. 4°. *Lund*, 1898. — ——

—— K. Sv. Vet-Akad. Förhandl. No. 7–9, 1898. Meddelanden från Lunds Astronomiska Observatorium. 8°. — The Observatory.

1. Ueber Kometenbahnexcentricitäten. I. Elis Strömgren. *Stockholm*, 1898. — ——
2. Eine Metode den Jupitersradius zu bestimmen. C. A. Schultz-Steinheil. *Stockholm*, 1898. — ——
3. Ueber akromatische Linsensysteme aus einer Glassorte. C. V. L. Charlier. *Stockholm*, 1899. — ——

Lussinpiccolo. Manora Sternwarte. Thätigkeit im Jahre 1897. [Naturwissenschaftliche Wochenschrift, Band XIII, Nos. 14 and 22.] 4°. *Berlin*, 1898. — ——

—— —— Astronomische Rundschau. 8°. Band I, Heft 1. *Lussinpiccolo*, 1899. — ——

Madras. Government Observatory. Report for the year 1897–98. 8°. *Madras*, 1898. — ——

Manchester. Literary and Philosophical Society. Memoirs and Proceedings. Vol. 42, Parts II–V. 8°. *Manchester*, 1898. — The Society.

Mexico. Observatorio Meteorológico-Magnetico Central. Boletin Mensual. Año de 1898. Núm. 5, 11. 4°. *Mexico*, 1898. — The Observatory.

Mansill, Richard. Almanac for the year 1899. 8°. *Rock Island*, 1899. — The Author.

Digitized by Google

The Observatory. Milan. R. Osservatorio Astronomico di Brera. [Estratto dai "Rendiconti" del. R. Ist. Lomb. Vol. XXXI, 1898.] Riassunto delle Osservazioni Meteorologiche eseguite nell' anno 1897. E. Pini. 8°. *Milano*, 1898

—— —— R. Istituto Lombardo di Scienze e Lettere. Memorie. Vol. XVIII, Fasc. V. Origine del Sistema Planetario Eliocentrico presso i Greci. Giovanni Schiaparelli. 4°. *Milano*, 1898.

The Office of Distribution. Montevideo. Ministerio de Fomento. Latitud de Montevideo. Enrique Legrand. 8°. *Montevideo*, 1899.

The Observatory. Morelia. Colegio Seminario. Boletin del Observatorio Meteorológico. Tomo I, Núm. 44. 4°. *Morelia*, 1898.

The Author. Mount Hamilton. Lick Observatory. Definitive Determination of the Orbit of Comet 1896 III. R. G. Aitken. 4°. [Reprint from Astr. Nachr., No. 3550–51.] *Kiel*, 1899.

The Association. New York. Mercantile Library Association. Annual Reports. 1–16 (1821–1838), 34 (1854), 53 (1873–4), 57–67 (1877–1888), 69, 70 (1889–1891), 73–78 (1893–1898). 8°. *New York*, 1855–1898.

The Publishers. —— The Jewelers' Circular and Horological Review. 4°. Vol. XXXVI, Nos. 18 to end. *New York*, 1898.

—— —— —— Vol. XXXVII. *New York*, 1898–99.

—— —— —— Vol. XXXVIII, Nos. 1–17. *New York*, 1899.

The Society. Ottawa. Literary and Scientific Society. Transactions. 8°. No. 1. 1897–98. *Ottawa*, 1898.

The Observatory. Oxford. University Observatory. Twenty-third Annual Report of the Savilian Professor of Astronomy to the Visitors of the University Observatory for 1897–98. 8°. *Oxford*, 1898.

The Academy. Padua. R. Accademia di Scienze, Lettere ed Arti. Atti e Memorie. 8°. Anno CCXCIX. (1897–98), Nuova Serie. Vol. XIV. *Padova*, 1898.

Digitized by Google

Paris. Bureau des Longitudes. Connaissance des Temps, pour l'an 1899. 8°. *Paris*, 1896. — Bureau des Longitudes.
—— —— —— 1900. *Paris*, 1897. ——
—— —— —— Extrait à l'usage des Écoles d'Hydrographie et des Marins du Commerce, pour l'an 1899. 8°. *Paris*, 1897. ——
—— —— Annuaire pour l'an 1899. 12°. *Paris*, [1898.] ——
—— —— Ephémérides des étoiles de culmination lunaire et de longitude pour 1899 par M. M. Lœwy. 4°. *Paris*, 1897. ——
—— —— —— pour 1900. *Paris*, 1898. ——
—— —— Annales. Travaux faits à l'Observatoire Astronomique de Montsouris et Mémoires divers. Tome V^ème^. 4°. *Paris*, 1897. ——
—— Enquêtes et Documents rélatifs à l'Enseignement Supérieur. LXVII. Rapport sur les Observatoires Astronomiques de Province. Année 1896. 8°. *Paris*, 1897. ——
—— Conférence Internationale des Étoiles Fondamentales de 1896. Procès-verbaux. 4°. *Paris*, 1896. ——
—— L'Observatoire Municipal de Montsouris. Annuaire pour l'année 1899. 12°. *Paris*, [1898.] The Observatory.
Perth, Western Australia. The Observatory. Meteorological Report for 1894. 4°. *Perth*, 1897. ——
Pola. Hydrographisches Amt der K. u. K. Kriegsmarine. Veröffentlichungen. Fortlaufende Nr. 5. Jahrbuch der Meteorologischen und Erdmagnetischen Beobachtungen. 1897. 4°. *Pola*, 1898. The Office.
—— —— —— Nr. 6. Erdmagnetische Reise-Beobachtungen. *Pola*, 1898. ——
—— —— —— Nr. 7. Relative Schwerebestimmungen durch Pendelbeobachtungen. *Pola*, 1898. ——
—— —— Meteorologische Termin-Beobachtungen in Pola und Sebenico. April 1898–März 1899. 4°. *Wien*, 1898–99. ——

Digitized by Google

The Observatory. Potsdam. Astrophysicalisches Observatorium. Publicationen. Director H. C. Vogel. 11ter Band. 4°. *Potsdam*, 1898.

—— —— —— —— 13ter Band. *Potsdam*, 1899.

—— Prague. K. K. Sternwarte. Magnetische und Meteorologische Beobachtungen im Jahre 1897. 58. Jahrgang. 4°. *Prag*, 1898.

The Society. —— Königl. böhmische Gesellschaft der Wissenschaften. Jahresbericht für das Jahr 1896. 8°. *Prag*, 1897.

—— —— —— —— 1897, *Prag*, 1898.

—— —— —— Sitzungsberichte der Mathematisch-naturwissenchaftlichen Classe. Jahrgang 1896. 8°. *Prag*, 1897.

—— —— —— —— 1897. *Prag*, 1898.

The Observatory. Pulcova. Observatoire Central Nicolas. Publications sous la Direction de O. Backlund. 4°. Série II, Vol. V. Observations faites au Cercle Vertical. Par H. Romberg. *St. Peterburg*, 1898.

—— —— —— —— Vol. XI. Beobachtungen der Saturnstrabanten. Von Hermann Struve. *St. Peterburg*, 1898.

—— —— —— —— [Extrait du Vol. III.] Ascensions Droites Moyennes des Étoiles Principales pour l'Époque 1885.0, par A. Sokolov. *St. Peterburg*, 1898.

—— —— —— [Imperial Academy of Sciences; Memoires: Series VIII, Vol. VII, No. 4.] Positionen der Jupiterstrabanten nach photographischen Aufnahmen berechnet, von F. Renz. I. Teil. Oppositionen 1891–1895. 4°. *St. Peterburg*, 1898.

—— —— —— [——] Positions préliminaires de 413 Étoiles dans la constellation des Gémeaux, qui seront occultées par la Lune le 27 Decembre, 1898. Par S. Kostinsky. 4°. *St. Peterburg*, 1898.

—— —— —— [——] Circular of O. Backlund, Director, Oct. 1898, with list and positions of stars to be occulted during the total Eclipse of Dec. 27, 1898, with ms. Ephemeris for New Haven. 4°. *Pulcovo*, 1898.

Digitized by Google

Richmond, England. Kew Observatory. Report of the Kew Observatory Committee of the Royal Society, for the Year ending December 31, 1898. 8°. *London*, 1899.	The Observatory.
Rome. Specola Vaticana. Pubblicazioni. Vol. V. 4°. *Roma*, 1898.	——
—— —— Tre Nebulose fotografate recentemente. P. Giuseppe Lais. 4°. *Roma*, 1899.	The Author.
Rugby. Temple Observatory. Report for the year 1896. [*Rugby*, 1897.]	The Observatory.
—— —— —— 1897. [*Rugby*, 1898.]	——
St. Louis. Academy of Science. Transactions. 8°. Vol. VII, Nos. 18–20. *St. Louis*, 1897–98.	The Academy.
—— —— —— Vol. VIII. *St. Louis*, 1898–99.	——
—— —— —— Vol. IX. *St. Louis*, 1899.	——
St. Petersburg. Izvestia Russkago Astronomitscheskago Obschtschestva, T. VI, No. 4. 8°. *St. Peterburg*, 1897.	The Society.
San Francisco. Astronomical Society of the Pacific. Publications. 8°. Vol. X, Nos. 62–65. *San Francisco*, 1898.	——
—— —— —— XI. Nos. 66, 67. *San Francisco*, 1899.	——
San Salvador. Diario Oficial [containing daily meteorological Reports of the Director of the National Observatory] Feby. and April, 3–15, 1899. Fol. *San Salvador*, 1899.	The Official International Exchange.
Stockholm. Observatorium. Astronomiska Iakttagelser och Undersökningar anställda på Stockholms Observatorium. Utgifna af Hugo Gyldén, Konigl. Vetenskaps-Akademiens Astrom. 4°. 6*e* Bandet, Häftet 3. Photographische Ausmessung der Plejaden. K. G. Olsson. *Stockholm*, 1898.	Royal Academy of Sciences, Stockholm.
—— —— —— [Title page and Preface to Vol. V.]	——
Sydney, N. S. W. Government Observatory. No. 140. Results of Rain, River, and Evaporation Observations made in New South Wales during 1896. H. C. Russell, Government Astronomer. 8°. *Sydney*, 1897.	The Observatory.

Digitized by Google

The Observatory. Sydney, N. S. W. Royal Society of New South Wales. 8°. Icebergs in the Southern Ocean, No. 2. H. C. Russell. *Sydney*, 1897.

—— —— —— Aurora Australis. H. C. Russell. *Sydney*, 1897.

—— Tacubaya. Observatorio Astronómico Nacional. Boletin. Tomo II, Num. 3–4. 4°. *Mexico*, 1898.

—— —— —— Anuario para el año de 1899. Año XIX. 8.°. *Mexico*, 1898.

The University. Tōkyō. Imperial University of Japan. (Teikoku Daigaku.) Calendar for the year 1897–98. 8°. *Tōkyō*, 1898.

The President. —— Earthquake Investigation Committee. Publications, No. 2. Preliminary Report on the Variation of Latitude at Tōkyō. H. Kimura. 8°. *Tōkyō*, 1898.

The Director. Toronto. Meteorological Service of the Dominion of Canada. Monthly Weather Review, Jany. 1898–March, 1899. 4°. *Toronto*, 1898–99.

—— —— —— General Meteorological Register for the year 1895. 8°. *Toronto*, [1896.]

—— —— —— —— 1898. *Toronto*, [1899.]

The Institute. —— Canadian Institute. Transactions. 8°. Vol. 5, Part 1, Supplement. *Toronto*, 1898.

—— —— —— —— Vol. 5, Part 2, *Toronto*, 1898.

—— —— —— Proceedings. 8°. Vol. I., Parts 3–6. *Toronto*, 1897–98.

—— —— —— —— Vol. II, Part 1. *Toronto*, 1899.

The Society. —— Astronomical and Physical Society. Transactions. 8°. For the year 1898, including 9th Annual Report. *Toronto*, 1899.

The Observatory. Upsala. [Review, by N. C. Dunér of] J. Scheiner, Untersuchungen über die Spectra der helleren Sterne nach photographischen Aufnahmen. (Publ. Astrophys. Obs. Potsdam, Nr. 26.) [Sonder-Abdr. aus V. J. S. der Astron. Gesellschaft. Jahrgang 32, Heft 3.] 8°. *Leipzig*, [1897.]

Digitized by Google

Upsala. [Doctorate Theses presented to the Upsala University. — The Royal University Library.

a. A. E. O. Andersson. Om en kvantitativ bestämning af värmevariationerna vid metalltrådars dilatation och kompression. 8°. *Upsala*, 1898.

b. Axel Brusiin. Studier öfvor några funktionalekvationer i form af additionsteorem. 8°. *Stockholm*, 1897. ——

c. Alfred Ekström. Om Teorien för elektriska svängningar i metalltrådar, framkallade af en Hertz' oskillator. 4°. *Stockholm*, 1897. ——

d. Ivar Fredholm. Sur les équations de l'équilibre d'un corps solide élastique. 4°. *Stockholm*, 1898. ——

e. Hakon Grönwall. Om system af linjära totala differentialekvationer särskildt sådana med $2n$-periodiska koefficienter. 4°. *Upsala*, 1898. ——

f. Erik Holmgren. Om en klass af partiella lineära differentialekvationer. 8°. *Upsala*, 1898. ——

Washington. American Ephemeris and Nautical Almanac, for 1900. 8°. *Washington*, 1897. — Office of the Amer. Eph. and Naut. Alm.

—— —— for 1901. 8°. *Washington*, 1899. ——

—— —— Astronomical Papers prepared for the use of——. Vol. VI, Part IV, Tables of Mars. 4°. *Washington*, 1898. ——

—— U. S. Coast and Geodetic Survey. Report of the Superintendent for the year ending with June, 1897. 4°. *Washington*, 1898. — U. S. Coast and Geod. Survey.

—— —— Bulletins. 4°.

No. 37. Alaska. Hydrographic Notes and Sailing Directions relating to portions of Alaska from Dixon Entrance to Yakutat Bay, &c., 1897. *Washington*, 1899. ——

No. 38. —— —— relating to the vicinity of Prince William Sound, Cook inlet, Kadiak Island, and Route from Unalaska to Chignik, through Unimak Pass and inside the Islands. 1897. *Washington*, 1899. ——

Digitized by Google

Dr. Wm. L. Elkin. — Washington. U. S. Department of Agriculture Weather Bureau. Report of the Chief, for the year ending June 30, 1897. 4°. *Washington*, 1897.

The Bureau. — —— —— —— Protection from Lightning. Alex. Mc Adie. 8°. *Washington*, 1894.

Dr. Wm. L. Elkin. — —— —— —— Monthly Weather Review. Mar. –Dec., 1898. 4°. *Washington*, 1898–99.

—— — —— —— —— Climate and Crop Bulletins. 1898, Nos. 10, 30. Folio. *Washington*, 1898.

—— — —— —— —— —— 1899, Nos. 1, 2. *Washington*, 1899.

—— — —— —— —— Meteorological Chart of the Great Lakes. Summary for the year 1898. Folio. *Washington*, 1899.

—— — —— —— —— Snow and Ice Charts. Dec. 5, 1898–Mch. 28, 1899. Folio. *Washington*, 1898–99.

The Observatory. — —— U. S. Naval Observatory. Report of the Superintendent for the year ending June 30, 1898. 8°. *Washington*, 1898.

Prof. W. H. Brewer. — —— —— Observations, 1899. — Appendix I. Magnetic Observations in 1892. *Washington*, 1893.

The Observatory. — —— —— Observations for 1892, Appendix I. The Second Washington Catalogue of Stars . . . with Annual Results upon which it is based . . . Reduced to the Epoch 1875.0. Under the direction of John R. Eastman. 4°. *Washington*, 1898.

Branch Office, New York. — Washington. U. S. Navy. Hydrographic Office. Pilot Charts of the North Atlantic Ocean. June, 1897–May, 1899. Folio. *Washington*, 1897–99.

The Observatory. — Williams Bay. The Yerkes Observatory of the University of Chicago. George E. Hale. 8°. *Chicago*, 1897.

—— — —— —— Bulletin No. 4. Addresses delivered in connection with the dedication of the Yerkes Observatory. 8°. *Chicago*, 1897.

Digitized by Google

Williams Bay. Bulletin No. 5. Proceedings of the Conference held at the Yerkes Observatory, Oct. 18–21, 1897. 8°. *Chicago*, 1897.

Windsor, N. S. W. Mr. Tebbutt's Observatory. Results of Meteorological Observations in the years 1891–97. *Sydney*, 1898.

Xalapa. Observatorio Central del Estado de Veracruz Llave. Boletin Mensual Meterológico y Agrícola. Noviembre de 1897–Febrero de 1898. 4.° *Xalapa*, 1897–98.

Zürich. Astronomische Mittheilungen gegründet von Dr. Rudolph Wolf. 8°. No. LXXXIX. Herausgegeben von A. Wolfer. *Zürich*, 1898.

In addition to the foregoing there have been placed upon the Library table, by Dr. Elkin, shortly after publication, as loans, the following periodicals:—

"Astronomische Nachrichten"; "The Astronomical Journal"; "Vierteljahrsschrift der Astronomischen Gesellschaft"; "Science" and "Nature."

THE THERMOMETRIC BUREAU.

The work in this department, under the charge of Mr. Peck, has continued about the same as during the preceding year.

Very respectfully submitted,

ROBERT BROWN,

Secretary of the Observatory.

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

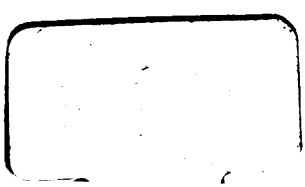
Digitized by Google

Digitized by Google

This book should be returned to the Library on or before the last date stamped below.

A fine is incurred by retaining it beyond the specified time.

Please return promptly.



Digitized by Google

Digitized by Google